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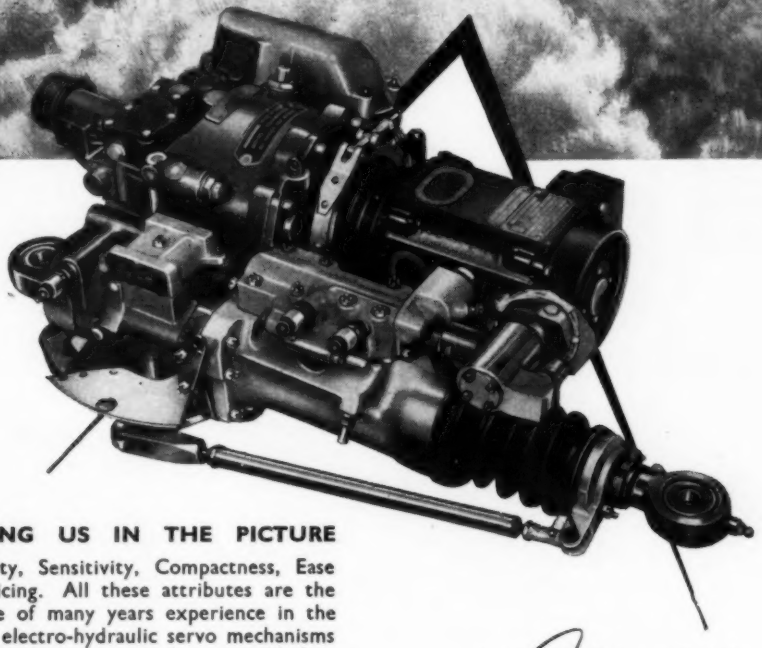

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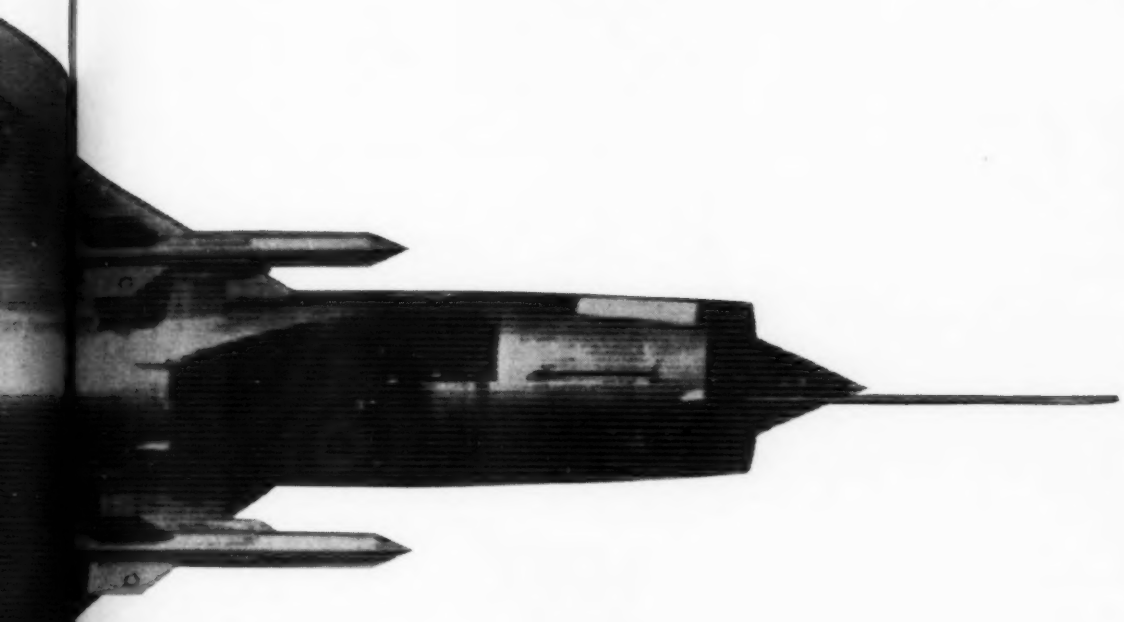

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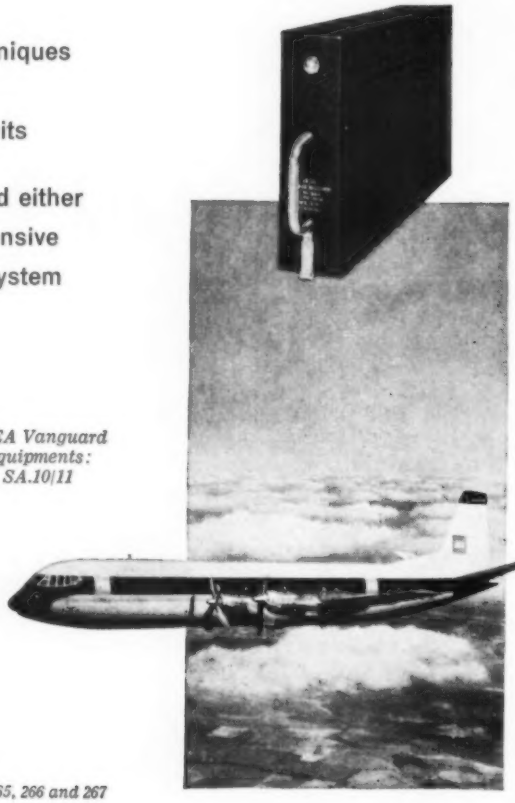

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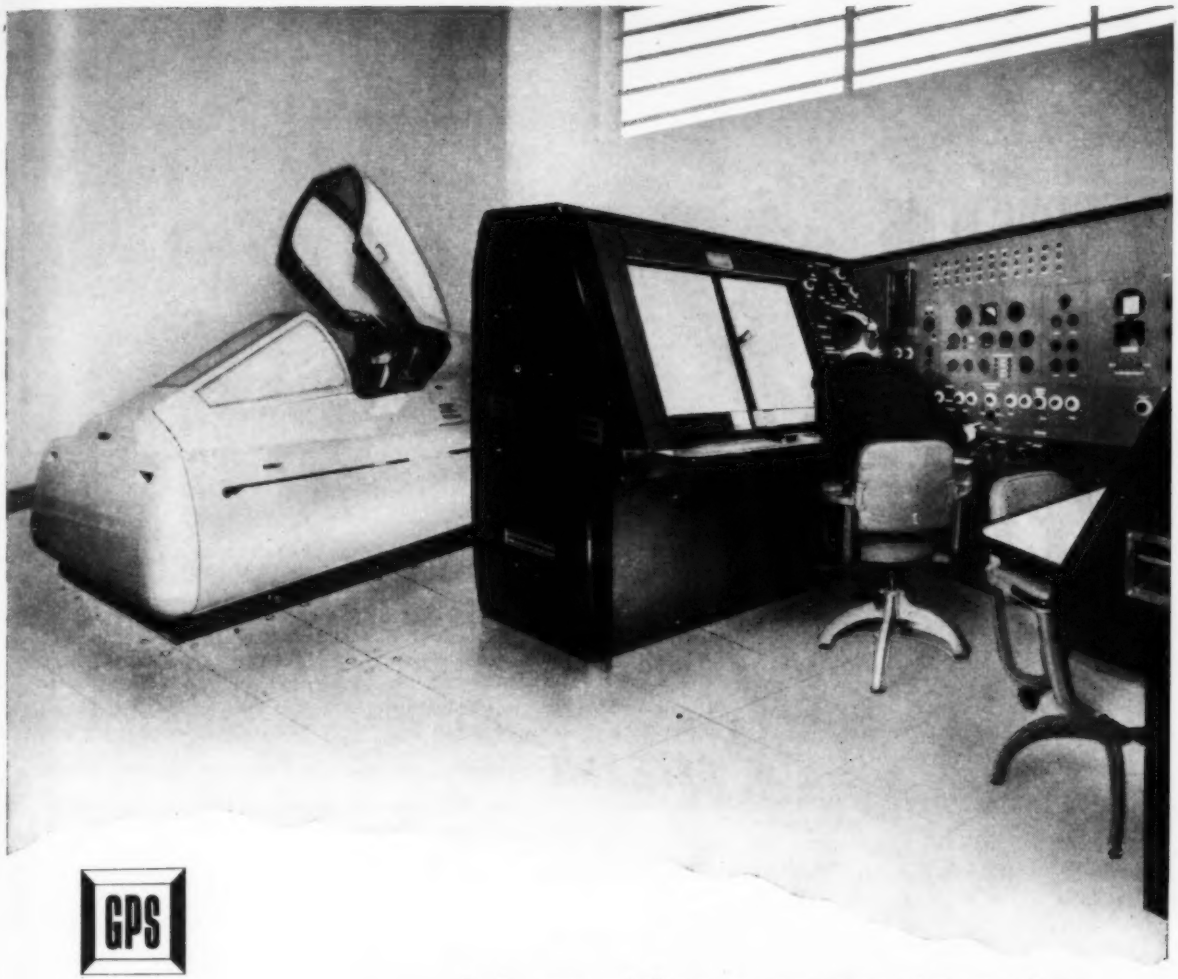

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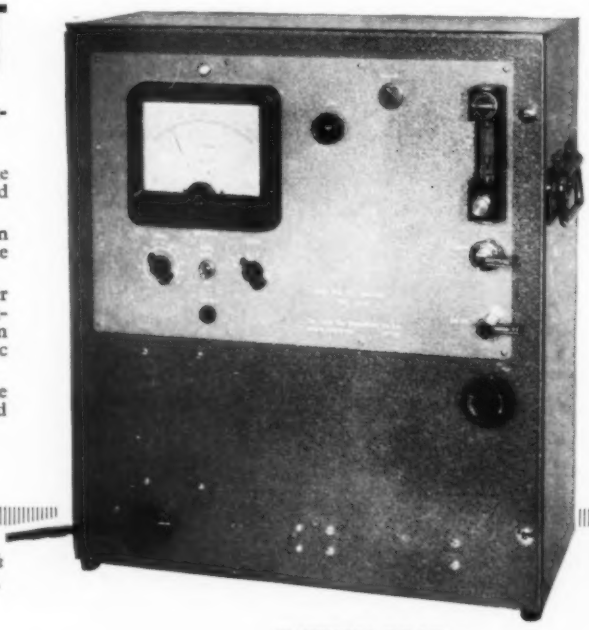

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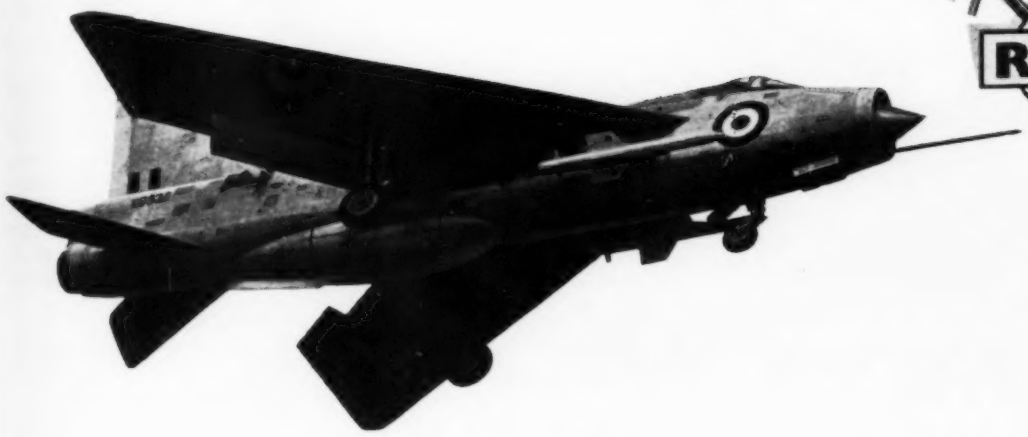

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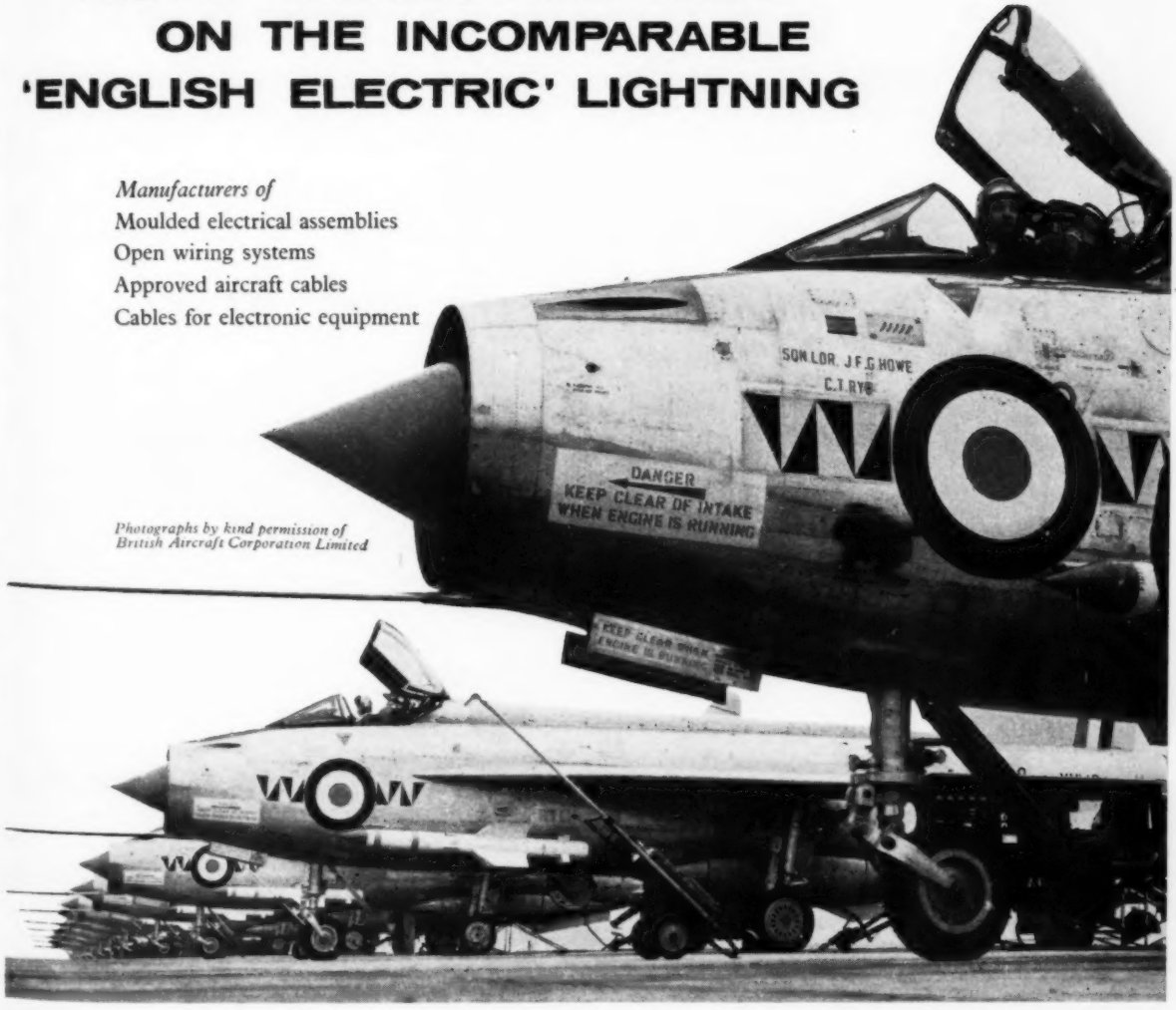

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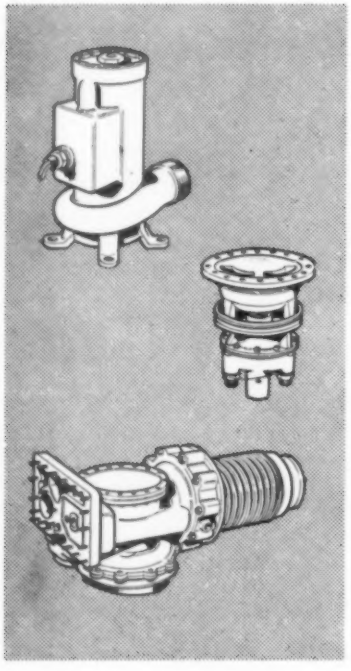

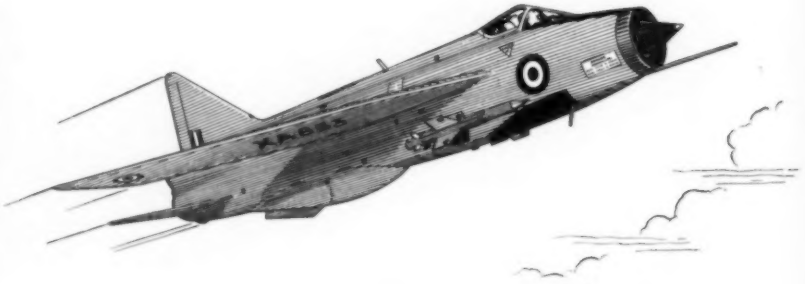

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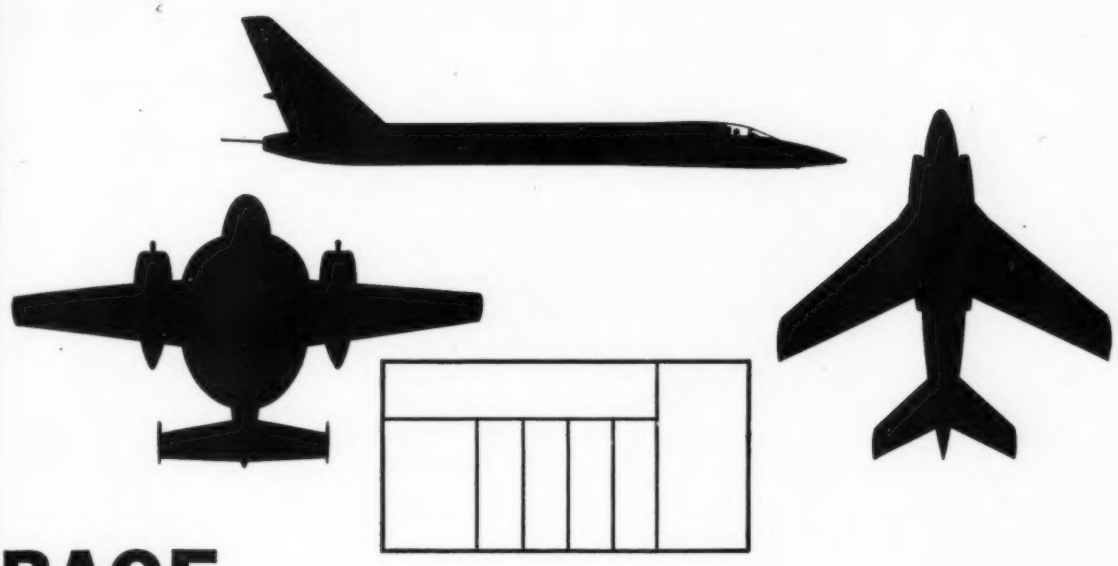

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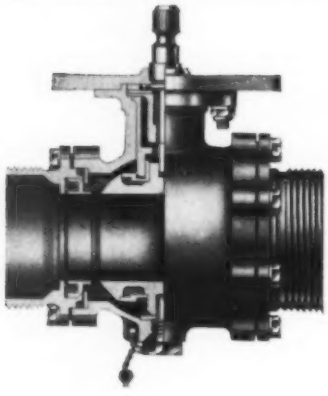

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No 2731 VOLUME 80 THURSDAY 13 JULY 1961

FLIGHT

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Iliffe Transport Publications Ltd, Dorset House, Stamford Street, London, SE1; telephone Waterloo 3333. Telegrams Flightpres London SE1. Annual subscriptions: Home £4 15s. Overseas £5. Canada and USA $15.00. Second Class Mail privileges authorized at New York, NY.

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Demonstration of Might

ON pages 52 and 53 we print a contribution on Russian civil aviation by one Stanislav Shcherbatov. Let us confess that we have not yet been able to discover the identity of Mr Shcherbatov. He may be a journalist, a propagandist, or a worker within the Soviet aircraft industry. On this occasion we are not greatly concerned, for his contribution is a welcome invitation to readers to visit the Soviet Exhibition now in progress at Earls Court.

In this issue, too, we print an account of the great display staged over Moscow's Tushino airfield last Sunday—an occasion declared by Air Marshal Sergei Rudenko, Deputy Commander-in-Chief of the Soviet Air Force, to have been intended "to demonstrate the might of Soviet aviation." The scale of the demonstrations, and the very advanced types of operational aircraft involved, have more than restored any lapse in aeronautical prestige which may have followed the Paris Show, where Soviet aviation was represented solely—if massively—by a Tu-114.

Our account overleaf mentions a very large and very impressive four-jet supersonic aircraft which—probably a bomber in its present form—has evident potential as the prototype of a transport. Other remarkable aircraft appeared over Tushino in profusion—or, having regard to the garbled nature of many reports, confusion. Positively identified, however, were a massive flying crane derivative of the Mi-6 and a big compound transport helicopter by Kamov. Thus, seen in what the Russians have openly publicized as a demonstration of might, are new shapes that may soon be casting their shadows across the civil markets of the world.

Third Force in Space

WITH the announcement of West German agreement in principle to a European space launch-vehicle organization and to the Anglo-French proposals for a vehicle based on Blue Streak, the way is open for a third force in space to be established. Although it is well to realize that the decision to go ahead with a European programme has not, in fact, yet been made, the will to get into space is clearly present and seems likely to overcome any major difficulties at the forthcoming inter-governmental meeting.

At this stage there are too many unknowns in Europe's space equation for any valid judgment to be made on the merit of the programme as a whole. There is, in fact, no programme at all for the *use* of the satellite-launching vehicles which are to be developed, although the European Space Research Organization may well be a likely customer in the purely scientific field. Who will operate the satellite systems which the proposed new European space launch-vehicle organization may make possible? Will the launch-vehicle organization do this, or will yet another new European organization be formed to develop, for example, a communication satellite system? How will the military desires in space of participating countries affect the basis of agreement? Will the European space club be exclusive?

In the period before these questions have to be answered, those concerned might usefully consider some of the more progressive ideas on the subject which were presented in the economic and political discussion sessions of the European Symposium on Space Technology, fully reported in last week's issue. On that occasion a US National Aeronautics and Space Administration spokesman gave a clear indication in favour of international co-operation between the USA and regional groups like the proposed European space club.

OPERATIONAL aircraft in the Tushino display, reported on this page, included Sukhoi (?) delta-wing fighters (right) and twin-jet multi-purpose aircraft (below)

FROM ALL QUARTERS

The Tushino Display

SOME half-a-million people are reported to have witnessed the massive display of Russian air power at Moscow's Tushino airfield last Sunday, July 9. The display—greatest show of its kind for five years—was notable for impressive new types of aircraft. Although photography by Western operators was banned at the last moment, the Russians themselves issued a selection of pictures, the more important of which are reproduced here and on page 34.

The most remarkable aircraft observed was a four-jet delta-wing type—probably a bomber, but appearing also to have potential as a transport. This very strongly resembles the design known by the NATO code-name "Bounder," but the outboard jets are tip-mounted, as seen in two illustrations opposite. Remarkable, having regard to probable M2 performance, are the plain pitot intakes.

Another supersonic bomber, also depicted opposite, generally resembles the type known by the NATO code-name "Backfin." It appears that missiles are carried under the swept wing, which has large boundary-layer fences. There are prominent under-fins. The intakes for the twin jets appear to be ahead of the wing leading-edge.

No photographs have been received of the reported supersonic bomber having twin jets at the rear, as on the Caravelle. A formation of ten of these is said to have flown over. This is probably the type described by the Russian commentator in these terms: "In the air are dart-shaped aircraft armed with air-to-ground rockets. The turbines are at the tail-end of the fuselage . . ." There may be some confusion between this reported type and that referred to in the foregoing paragraph.

A formation of fifteen "Bear" turboprop bombers flew over carrying air-to-ground missiles, said by the commentator to be "capable of destroying any target hundred of kilometres away." It was further stated of the "Bears" that "their up-to-date equipment enables them to see the target from far away."

Also represented were "multi-purpose aircraft" generally resembling the type known by the NATO code-name "Flashlight B." The parallel-chord wings, outboard of the nacelles, have dog-tooth leading edges, and there is what appears to be a ventral radome. The shape of the nacelles suggests that afterburners are fitted.

Two types of delta-wing supersonic fighter were identified. One, illustrated in *Flight* last week, appears to have twin jets and is also characterized by a "bullet" fairing in the circular intake. The other type generally resembles the (apparently) single-jet type known by the NATO code-name "Fishbed." Both carried missiles.

An unspecified type of fighter—probably a Mig—used rocket-assisted take-off. Ground run was about 100 metres. Another aircraft, possibly a fighter, was "a liquid-fuel rocket aircraft."

The Soviet Navy was prominently represented. At one point the commentator said: "Soviet naval aircraft are now flying past. They look like darts, with turbine engines mounted in the wing-tips. They also carry rockets under the fuselage." Another reference to naval aircraft was: "Naval search-and-attack jets appeared, dropping buoys [sonobuoys?] on the field." A twin-jet flying boat was reported and was described as "sleek." Reference was also made to "jet aircraft for the detection and destruction of submarines far away from Soviet shores."

Advanced types of helicopter appeared, the most remarkable being the very large flying crane depicted on page 34 and which carried a prefabricated house. This is evidently a Mil design and the turbines are arranged as on the Mi-6. The type is said to be capable of carrying 180 men.

The winged Mi-6 was also represented, one helicopter of this type carrying what was said to be a replica of the spaceship *Vostok*. Aircraft of this type also apparently landed rocket-armed troops. The commentator said: "We can see a land-to-land rocket."

Unfortunately no photographs have been received of a new compound helicopter by Kamov. Described as a "huge troop- and cargo-carrying vertical take-off plane," it is called by the Russians "Vinto-kryl" ("screw wing"). This machine was also described as "the most powerful vertical take-off machine in the world." One report described it as looking like an ordinary airliner with rotor blades mounted above turbine engines at the wing-tips. Also present was a turboprop helicopter capable of carrying 35 rocket-armed troops. A flight of these appeared. This seems to have been the machine described by the commentator as "the new passenger-carrying turbine-powered helicopter designed by Mil, with a seating capacity for 35." Reference was also made to new "sporting jet planes" constructed by Yakovlev.

Kenya Airlift

AT RAF Lyneham last Thursday the Secretary of State for Air, Mr Julian Amery, watched the airlift of 19 Infantry Brigade to Kenya and spoke of "the value of perfect co-operation between the RAF and the Army." The two Services had been "practising this sort of thing for some three years." In the present instance, Transport Command had provided 70 aircraft within 48 hours. Over a thousand troops were moved and more than 100 tons of freight; it was the biggest and swiftest airlift of its kind ever undertaken. Squadrons participating were Nos 99 and 511 (Britannias) and 216 (Comets).

Bloodhound 2s for Sweden

SWEDEN'S Bloodhound 2 order (see page 40) means much more than "just another foreign sale." The fact that British guided weapons have been ousted from all NATO deployment could not be taken as an indication of inferiority, since Britain was not prepared to offer weapons on the give-away terms of Nike-Ajax and Hercules and the European-produced Hawk. Whatever British companies and ministers may claim for their products, the only certain criterion of technical excellence is export success in the face of genuine competition, and this Bloodhound 2 has achieved. Bloodhound 1 was fully described in *Flight* for October 23, 1959, and all that can be said of Bloodhound 2 was contained in our September 16 issue last year.

Hawker Siddeley's Year

IN his speech to shareholders of the Hawker Siddeley Group at the annual general meeting in London on July 5, Sir Thomas Sopwith, the Group's chairman, said: "This is our Silver Jubilee year. Twenty-five years ago I reviewed the first year of operations for the Hawker Siddeley Group. Our gross sales then were £6 million. Today, 25 years later, I am glad to report gross sales of £458 million for the 17 months period covered by our accounts, a figure roughly equal to £324 million for a comparative 12-month period. I think it can be fairly said that this is a substantial record of growth." Total Group profit after taxes was £7,771,146.

SUPERSONIC bomber (probable) and transport (possible) which appeared over Tushino is shown in the two pictures on the right. The aircraft very strongly resembles the design formerly known by the NATO code-name "Bounder," but the outboard jets are tip-mounted

SUPERSONIC bomber (below), also appearing over Tushino, generally resembles the type known by the NATO code-name "Backfin." It appears that missiles are carried under the wings. Intakes for the twin jets seem to be positioned ahead of the leading edge

Discussing HSG expansion Sir Thomas said: "This has been another period of remarkable growth. Since my last report we have acquired the de Havilland and Blackburn companies, thus supporting the Government's policy of concentration in the aircraft industry. Having done all this at great expense, and having brought these two most excellent companies into our Group, I now sincerely hope that the Government will do their part and support us."

Sir Thomas said that the Group's range of aviation products was probably the widest of any company in the world. Of the Hawker P.1127 he said that this and its derivatives must have a great future. It began as a private venture but had now received welcome Government support. The Armstrong Whitworth Argosy promised to find an active market, and it was expected that the de Havilland Trident would fly "soon after the year end." The Avro 748 was "progressing well." Later in his speech Sir Thomas said: "We have written off £15 million in our current accounts on design and development for civil aircraft, but we cannot afford to continue to absorb such heavy expenditures. It may be said that our foreign competitors must also expend similar monies to develop their new civil aircraft but the difference is that they all have substantial home military orders with an export potential, profits from which can be used to support these civil developments. Private venture projects involving this kind of development expense are essential if we are to maintain our position in the world civil air transport market. But we can only carry forward these projects if we get continuing and substantial Government support."

Concerning space Sir Thomas reported: "As a company we have done everything we can and we are now awaiting the vital policy decision from our Government. It is now that Britain must decide to embark on a major space programme—or never! Communications satellites should be the first general peaceful use of space and the returns from this application will amply justify the investment in developing the necessary capital equipment. Without a space programme we shall relinquish not only our right to be taken seriously in the political and military council chambers of the world, but also of remaining amongst the leaders of world technology. Our whole technical future is inextricably bound up with our future in space and, to me, it is unthinkable that this nation will stand aside from space development and allow all its potential advantages to evaporate and disappear by default."

Francis McKenna

IT is with regret that we record that Francis McKenna, FRAeS, FRSA, consultant to the directors of Beagle-Miles Aircraft, died recently in hospital at Chichester at the age of 69. He had had a long career in the aviation industry, largely with Gloster Aircraft, with whom he served for twenty-four years.

Mr McKenna's experience went back to the First World War, for he joined A. V. Roe in 1914 and the Nieuport Co in 1917. He took up a Gloster appointment in 1922, as production manager, later becoming works manager and subsequently general manager (1930). In 1938 he was made a director, remaining on the board until he resigned in 1946. During his directorship Mr McKenna was closely associated with Sir Frank Whittle in work on the Gloster/Whittle E.28/39, and with wartime production of Hawker Hurricanes, which rose to a peak of one every four hours in the 1940-41 period.

Russia at Earls Court

AS already intimated, the products of the Russian aircraft industry are represented at the Soviet Exhibition at Earls Court principally by models. The following figures are quoted. The first entry indicates passenger seats; the second, payload; third, max speed; fourth, cruising speed; fifth, "range up to"; sixth, cruising height.

Il-18, 73-111; 14,000kg; 750km/hr; 650km/hr; 5,000km; 8,000-10,000m. **An-10A,** 100-132; 14,500kg; 715km/hr; 650km/hr; 3,500km; 8,000-10,000m. **Tu-124,** 44-60; "7 tons"; 1,000km/hr; 800-900km/hr; 2,000km; 12,000m. **An-24,** 32/40; 4,000kg; 510km/hr; 475km/hr; 23,000km; 6,000-8,000m. **"Tu-1045,"** 100; 12,000kg; 1,000km/hr; 800-900km/hr; 3,000-4,000km; 12,000m. **Tu-114,** 170-220; "30 tons"; 950km/hr; 750-800km/hr; 10,000km; 10,000-12,000m.

Helicopters: first entry indicates passenger seats; second, max speed; third, cruising speed; fourth, range; fifth, take-off weight.

Yak-24N, 39; 210km/hr; 180km/hr; 300km. **Mi-6,** 70-80; 300-350km/hr; 270km/hr; 500m; "39 tons." **Mi-1 Moskvitch,** 3; 205km/hr; 140km/hr; up to 590km. **Ka-18,** 3; 150km/hr; 120km/hr; 400-750km. **Mi-4,** up to 16; 210km/hr; 160km/hr; 500m.

A film is being shown to illustrate the various uses of helicopters —flood relief; ambulance work; helping with fishing; whaling and

FROM ALL QUARTERS...

LIGHTNING PRODUCTION is not a strictly accurate description of what is going on inside English Electric's factory at Samlesbury, Lancs, since each of the RAF's great twin-engined, supersonic, all-weather fighters consumes many tens of thousands of man-hours. This is one of the first such photographs to be published, and we include it here to introduce the full history and description of the aircraft which begins on page 44

hunting; crop-spraying; cargo-carrying; work on building sites; scout routes for ships in Polar regions; fire fighting, hoisting bogged-down vehicles, etc. Models of four Sputniks are on view, on a raised circular site, the walls of which are covered with diagrams and with pictures of Maj Gagarin, space dogs, equipment and achievements. There is also a film show, including rocket launching, the roof of the stand being lit up to show "the route to the stars." Maj Gagarin and spaceflight are the theme throughout. A package for a special brand of cigarettes—on sale in London—shows sputnik and space dogs, and there are decorated boxes of food. In the art section is a model of the monument—by Faidysh-Krandievsky—commemorating the first satellite. On the record stand two of the discs on sale are "Conquest of Space" (9s 6d) and "Speaking from Space (6s 4d).

(See "Russian Aircraft and Earls Court," p 52.)

IN BRIEF

Certification of the DHC-4A Caribou at an increased gross weight of 24,000lb to CAR 4b, Transport Category, by the Canadian Department of Transport has been announced by de Havilland Aircraft of Canada.

The Royal Aeronautical Society have arranged a lecture of exceptional interest for tomorrow, July 14. Dr Bobrov, chief scientist of the Astronautics Society of the Soviet Academy of Sciences, who has been giving lectures this week at the Soviet Exhibition, has agreed to deliver an illustrated technical address entitled *Spacemen and Space Neighbours of the Earth* in the Society's main lecture theatre at 6 p.m.

Following completion of the two-year post-graduate course, 62 students received the Diploma of the College of Aeronautics at the Annual Presentation Day ceremony at Cranfield on July 7. Prize winners included C. G. B. Mitchell (Governors' Prize, SBAC Prize in Aircraft Design, RAeS Prize for 1960); K. F. Shepard (SBAC Prize in Aircraft Economics and Production); and Martin Holmes (SBAC Prize in Aircraft Propulsion). Awards were presented by Mr Alan Bullock, Master of St Catherine's College, Oxford.

Coventry Contests

TODAY (July 13) and for the next two days the Lockheed Aerobatic Trophy and King's Cup Air Race are being held at Coventry. Preliminaries of the aerobatic trophy take place today and the finals tomorrow; the race, and the Coventry Air Pageant, take place on Saturday.

Entry to the Royal Aero Club enclosure at Coventry Airport is 10s for adults, 5s for children under 15; car-parking is 3s 6d.

KING'S CUP RACE ENTRIES AND CHAMPIONSHIP PLACINGS

Pilot	Aircraft	London-Cardiff Race				Short-circuit Race			
		Place	Speed	Points	Bonus	Place (class)	Speed	Points	
B. G. K. Maile or N. Jones	Tiger Moth	12	101	24	—	6(3)	101	20	
G. Marler	Miles Falcon 6	6	167½	18	—	3(1)	167½	26	
R. H. McIntosh	Cessna 175	5	139	20	2	5(1)	138	22	
P. B. R. Vanneck	Tiger Moth	23	97½	14	—	2(3)	103½	28	
P. G. Masefield	Chipmunk	17	133½	22	—	6(2)	130½	20	
R. Crowhurst	Comper Swift	20	123	20	—	8(2)	123½	16	
I. Trethewey	Tiger Moth	19	112½	20	—	8(3)	114½	16	
T. G. Knox	Proctor 3	9	152½	14	—	6(1)	153½	20	
C. P. Francis	Turbulent	29	89½	10	—	5(2)	97	32	
J. M. Donald	Tiger Moth	33	85½	10	—	5(3)	104½	22	
Miss S. Scott	Jackaroo	21	99½	18	—	9(3)	100½	14	
G. P. Watson	Proctor 3	2	150	26	8	1(1)	147	30	
S. M. Aarons	Hawk Trainer 3	13	130½	28	—	1(2)	133	30	
G. Rees	Tiger Moth	8	102½	28	—	1(3)	106½	30	
P. Blamire	Gemini 3c	4	168½	22	4	2(1)	168	28	
R. R. Paine	Hawk Speed 6	3	190½	24	6	4(1)	183	24	
M. B. Iles	M18/2	14	133½	26	—	3(2)	134½	26	
J.W. G. Judge	Tiger Moth	11	102½	26	—	3(3)	104	26	
V. H. Bellamy	Spitfire 8	1	318	28	10	10(1)	135 *	12	
C. Gregory	Taylorcraft Plus D	16	107½	24	—	4(2)	109	24	
D. Hartas	Arrow Active 2	24	129½	18	—	2(2)	137	28	
C. E. Elton	Tiger Moth	18	112	22	—	4(3)	117	24	

* Rapide.

GIANT HELICOPTERS which appeared in last Sunday's Tushino display, reported on page 32, included the Mi-6, seen on the left carrying what was said to be a replica of the spaceship "Vostok," and a new, and extremely impressive, type of flying crane somewhat resembling the Mi-6 in layout. It showed itself capable of carrying a prefabricated house (below)

Missiles and Spaceflight

GERMANY AGREES TO ANGLO-FRENCH PLAN

THE Federal German Government has now made known its willingness in principle to participate in a European organization for the development of space vehicle launchers in the sense of the Anglo-French proposals issued at the Strasbourg Conference in February 1961.

"It will be recalled that these proposals aimed at the creation of an organization for the production of such launchers for peaceful purposes.

"The information is being passed by the French and British Governments to the other governments concerned. It is expected that their replies will shortly be received.

"The Governments of France and the United Kingdom hope to be able to call soon a conference to draft the necessary Convention."

This announcement by the Ministry of Aviation on Wednesday of last week, July 5, ended the uncertainty which had remained since the Strasbourg meeting concerning Europe's plans in space. It appeared probable that many of the smaller European countries would follow West Germany's lead; and also probable that, even if they did not, the big three would be prepared to go ahead alone.

The essentials of the initial programme which was proposed at Strasbourg are summarized in the accompanying diagrams. The drawing (below) is the first to show the configuration of the three-stage vehicle envisaged; and the chart overleaf outlines the development programme which would result from the spending of the much-quoted £70m. This programme and this sum of money would be only the start; plans for an operational satellite system of any kind, for example, are not included.

Full details of the official Anglo-French proposals as put forward at Strasbourg were published exclusively in *Flight* of February 17. Additional performance information and a complete weight analysis for the launch vehicle are presented below.

The first stage of the vehicle consists of Blue Streak, stripped of its military guidance equipment and warhead and with a modified separation bay tailored to carry the second stage. The French second stage will use the high-energy hypergolic propellant combination of nitrogen tetroxide and unsymmetrical dimethyl hydrazine. It was declared at Strasbourg that the third stage would be the responsibility of a country or countries other than Britain and France.

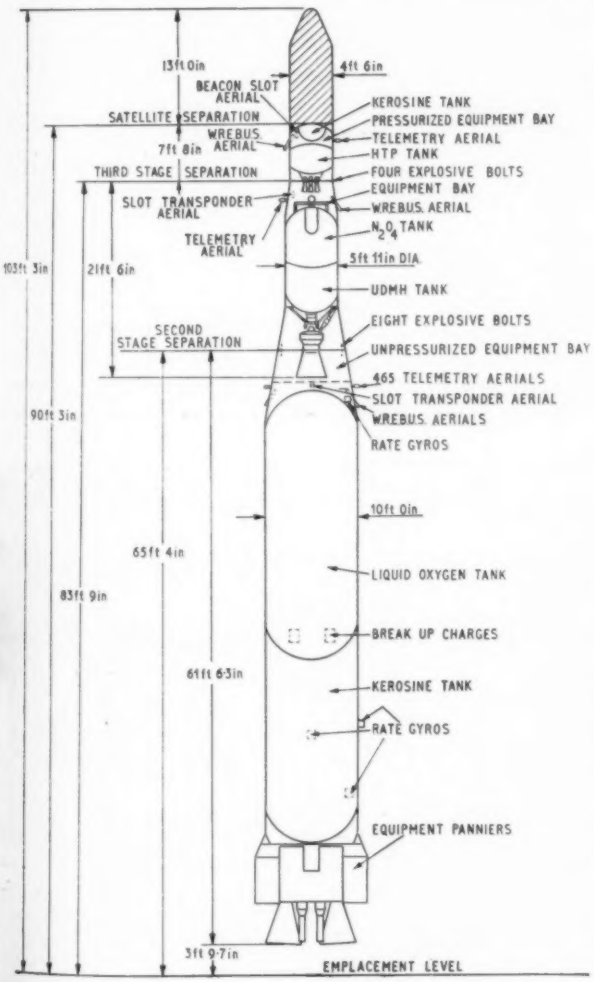
In Bonn on May 5 it was stated that the West German Government decision followed a favourable report on the Anglo-French proposals by a team of 12 scientists. According to Reuter, three conditions were attached to the approval in principle: (a) that other projects be studied and executed; (b) that West German industry should participate in work on the first and second stages and should have a "considerable share" in the third; and (c) that attempts be made to co-ordinate a European space research programme closely with that of the United States.

The new organization which, all being well, will be established following the forthcoming inter-governmental conference will be controlled by a body on which the governments of all participating countries will be represented. Within the framework of the Convention this body will determine the policy of the organization and supervise the agreed programme. As part of its initial work it will decide which countries are to develop the third stage and the various satellite test vehicles for proving the launch vehicle.

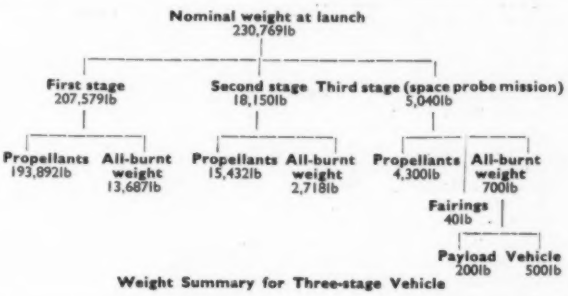
The staff of the organization will include representatives from each of the member States, and the development and construction of launch vehicles and test satellites will be carried out by means of contracts placed either by the organization or by individual States. The allocation of contracts and subcontracts will be determined by the organization on the basis of a rational distribution of work among members.

Arrangements will be made for technical information acquired in the course of any project to be freely exchanged by member countries. All participants will be given an opportunity of joining in the scientific, engineering and other work of the organization. The dissemination of knowledge will be helped by the employment of nationals of each member State in the work being undertaken on behalf of the organization in government establishments and industrial firms of other countries.

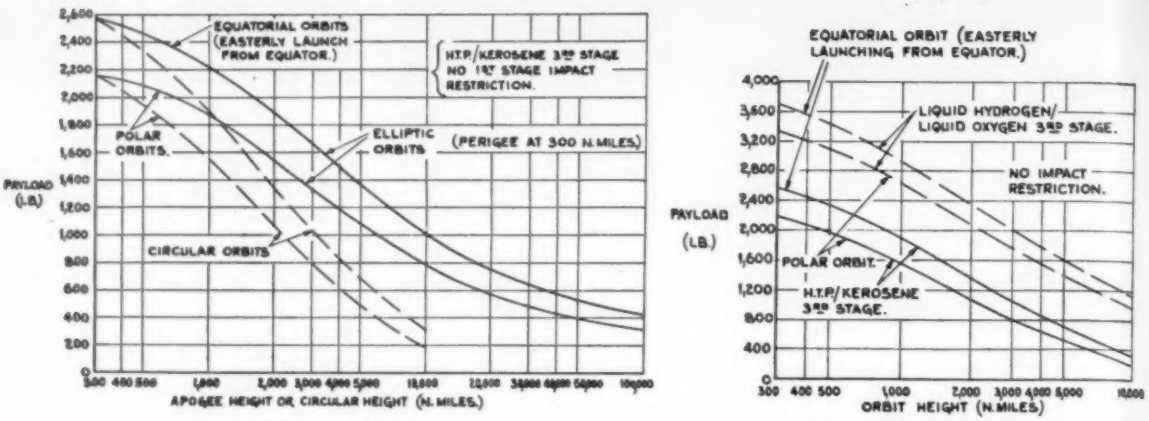
The new launch-vehicle organization will maintain close co-operation with the projected European Space Research Organization (ESRO). It is envisaged—by the Ministry of Aviation—that ESRO would wish to use launch vehicles produced by the proposed new organization. (*Continued on page 36*)



First diagram to show the main features of the proposed European three-stage launch vehicle based on Blue Streak as first stage and a French second stage. Performance details and a five-year programme outline are depicted overleaf



Weight Summary for Three-stage Vehicle


EQUATORIAL ORBITS (EASTERLY LAUNCH FROM EQUATOR.)
H.T.P./KEROSENE 3RD STAGE NO 1ST STAGE IMPACT RESTRICTION.
POLAR ORBITS.
ELLIPTIC ORBITS (PERIGEE AT 300 N.MILES)
CIRCULAR ORBITS
PAYLOAD (LB.)
APOGEE HEIGHT OR CIRCULAR HEIGHT (N. MILES.)
EQUATORIAL ORBIT (EASTERLY LAUNCHING FROM EQUATOR.)
LIQUID HYDROGEN/ LIQUID OXYGEN 3RD STAGE.
NO IMPACT RESTRICTION.
POLAR ORBIT.
H.T.P/KEROSENE 3RD STAGE.
PAYLOAD (LB.)
ORBIT HEIGHT (N.MILES.)

Left, nominal payloads for circular and elliptic orbits, assuming HTP/kerosene third stage in the three-stage vehicle. Right, higher performance is obtained by introduction of liquid hydrogen/lox third stage; circular orbits are shown

Missiles and Spaceflight . . .

A timely description of the proposed three-stage vehicle was given on the day of the announcement of the West German decision by Mr D. J. Lyons, Acting Head of the Guided Weapons Department of the Royal Aircraft Establishment, Farnborough, in a paper presented at the Oxford convention of the British Institution of Radio Engineers (reported on pages 37-38). Concerning the third stage, Mr Lyons said:—

"No firm joint European proposals have been made regarding the design and construction of a third, end stage, for final injection into orbit, but in order to demonstrate the capabilities two propellant combinations have been considered in assessment of a possible third stage. The first, hydrogen peroxide (HTP)/kerosene, a conventional, relatively low-energy propellant combination, was considered for its comparative ease of development. The second, liquid hydrogen/liquid oxygen, yielding a greatly improved performance in terms of payload, especially in distant orbits, demands more extensive development.

"Only the final stage need be varied to meet a widely varied series of orbit requirements without significant departure from optimum staging conditions."

On the subject of performance the speaker stated:—

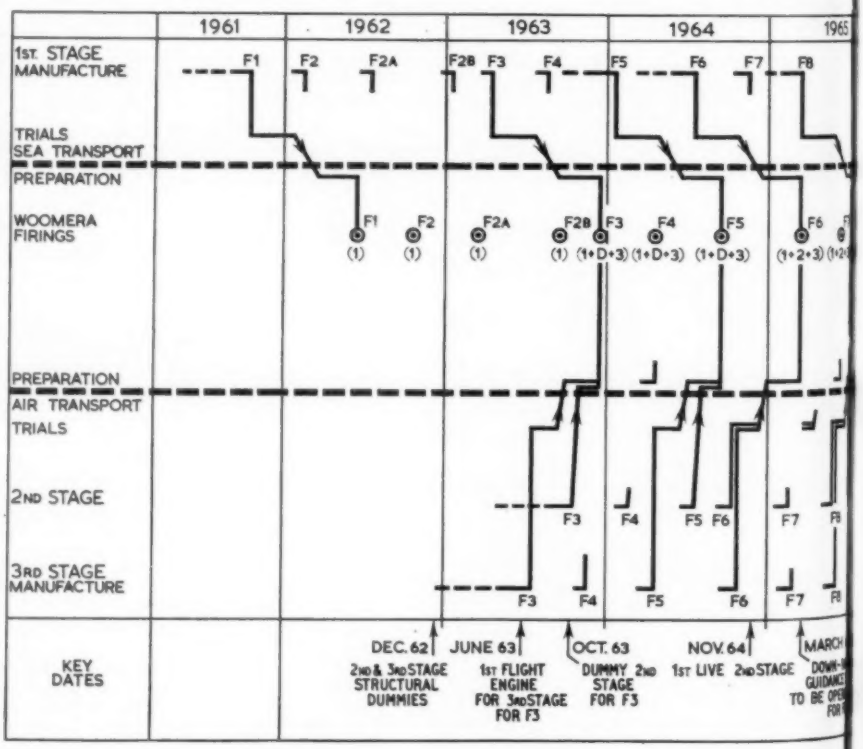
"It is possible to meet the varying orbital requirements by exchanging payload weight for propellent weight in the third stage whilst maintaining constant the overall weight of the third stage plus satellite payload at some 5,000lb, that is, the third stage incremental velocity can be increased at the expense of payload. The tank volume, only, is altered to suit the orbital mission, allowing the remainder of the third stage, including the engine and all equipment, to remain sensibly unchanged.

"The figure (above left) shows the estimated payload capability of the launcher with the illustrative HTP/kerosene end stage. These are based upon the indicated weight breakdowns, and a sea-level take-off thrust of 300,000lb (i.e., 2 × 150,000lb), and with exchange between payload and propellent weight with mission in the third stage, as mentioned earlier. As will be seen, the payloads vary from 1 ton actual payload in a 300 n.m. circle to 500lb in a 6-7,000 mile circle or in an elliptical orbit out to about 50,000 n.m. from a 300-mile perigee.

"In obtaining these results, stage weights and flight programmes have been optimized as far as possible. In general the stage weight/payload curves are fairly flat around the optimum point, and it has been found advantageous to choose end weights slightly off optimum on the "light" side for a number of reasons, such as, for example, the location of the impact point of the discarded first stage in an acceptable area.

"The 'payload into orbit' figures are considerably improved, as would be expected, using a liquid hydrogen/liquid oxygen third stage, as will be seen from the second figure (above right). This is especially marked in distant orbits, where the third-stage effective incremental velocity becomes a much larger proportion of the whole mission characteristic velocity. A payload of about 1¼

(*Concluded at foot of page 38*)



Although target dates have presumably slipped because of the delay in making the final decision to go ahead, this development programme, put forward at Strasbourg by the French and British Governments, outlines the main phases in the initial launch vehicle development plan. Costing some £70m, this programme would result in three firings of the complete vehicle in 1965. Firings F1 and F2 are of the first stage only, with F2A and F2B as back-up launches; F3, F4 and F5 would carry a dummy second stage and live third stage; and F6, F7 and F8 represent the three-stage vehicle

SPACE RADIO MEETING IN OXFORD

"RADIO Techniques and Space Research," the theme of the 1961 Convention of the British Institution of Radio Engineers held at Oxford during July 5-9, produced over 40 papers concerned with the scientific, engineering and electronic aspects of the subject. Extracts from the papers by Mr D. J. Lyons of the Royal Aircraft Establishment and by Mr John D. Nicolaides of the US Bureau of Naval Weapons are discussed in the preceding and following articles; other points from the Oxford meeting are reported here.

In *The Canadian Defence Research Board Topside Sounder Satellite*, R. C. Langille and J. C. W. Scott described the ingenious extending aerials devised for this satellite, which is to be launched into a 625-mile, 80° orbit by a NASA Thor-Agena vehicle during next year. Rather similar in concept to a carpenter's steel rule, these aerials comprise thin steel tapes which are unrolled and extended by an electric motor. Four of these types are used to erect two dipole aerials, one 150ft and the other 75ft from tip to tip. An example of one of these aerials, built by de Havilland Aircraft Co of Canada, was demonstrated by Mr G. K. C. Pardoe at the meeting.

The mechanical, structural and electrical properties of these aerials are to be tested under flight conditions, the Canadian authors disclosed, by means of a Javelin research rocket. Two of the 73½ft sounding aerials will be launched in a Javelin and ejected at high altitude. The rocket will be de-spun to about 329 r.p.m. before the experiment in order to give a realistic dynamic environment during ejection of the aerials. The maximum expected bending moments on the aerial tubes will be applied in the transient manner anticipated in the satellite experiment—a loading which would be extremely difficult to reproduce in a ground test. Construction of a Javelin nosecone with aerials and instrumentation is currently under way.

The satellite package will be a near-spheroid approximately 42in in diameter and 34in high, and weighing some 275lb. A large part of the surface is covered with 6,480 silicon solar cells which will charge the nickel cadmium batteries. Except for the electronics the satellite is being designed and built by de Havilland Aircraft Co of Canada, to specifications supplied by the Defence Research Telecommunications Establishment. Electrical design of the aerials is by Sinclair Radio Laboratories.

The Canadian satellite experiment is one of two authorized by the US National Aeronautics and Space Administration to sound the upper side of the ionosphere by radio means. It will be a sweep-frequency sounder covering the frequency range from 1.8 to 11.5 Mc/s, similar in operation to that of a ground ionospheric station. The second satellite, being developed in the USA, will sound on six frequencies in rapid succession. The data collected by both satellites will be telemetered to the ground and received at the same ground stations. The DRB satellite will concentrate on high-latitude problems, while the fixed-frequency sounder will be concerned more with studying the ionosphere to the south and, in particular, along the 75° parallel.

Mr D. J. Lyons, Acting Head of the Guided Weapons Department of the Royal Aircraft Establishment, Farnborough, presented a paper on *Satellite Launching Possibilities*. The general section of this paper gave the following description of methods of injection into orbit: Mr Lyons' remarks on launching by aircraft are particularly interesting in view of the American views on this topic reported on page 39, and his discussion of continuous-thrust techniques is also significant.

Practically all known satellite launching attempts [Mr Lyons stated] have been made with all-rocket systems. In such a system the initial launching is vertical, as maximum efficiency is achieved with very low initial acceleration (sometimes as low as ¼ g), but as the orbital velocity is required in a more or less horizontal direction the flight path is curved towards the horizontal as soon as is possible in order to start acquiring horizontal velocity. The rate of turn is limited by requirements to keep the speed down whilst the booster is still in the atmosphere in order to keep aerodynamic heating and loads within reasonable proportions. As the stages burn out they are jettisoned and the succeeding stages ignited just before, during or after separation.

In the most usual system all but one of the stages are burnt in rapid succession and have fairly high mean accelerations, firstly so as to derive the maximum possible energy-increase for given momentum increases and secondly to minimize the gravity losses. Since, however, this results in burn-out at a fairly low altitude and the launching vehicle must enter the required orbit under power, a coast period is usually inserted between the penultimate stage and the end stage while altitude is being gained. The final stage is ignited near orbital altitude to increase the energy to that needed to remain in the desired orbit.

This might be termed the thrust-coast-thrust type of injection. It has the added attraction that on a simple mathematical approach it has the virtue of being the most efficient method of injection from the point of cessation of thrust of the first stages; its disadvantages are also clear. Orientation systems have to be carried to hold spatial axis references for controlling direction of the end-stage thrust, and there may be additional problems caused by the necessity to start the end-stage engines from conditions of free fall when liquids will not be nicely placed in their required position in the "bottom" of the tanks.

An alternative method which has been evaluated in UK has been the elimination of the coast period and the substitution of a continuous but very low thrust end stage so that cessation of this thrust and attainment of initial orbit conditions are met at the same time. The advantages of this method are numerous:

(i) The low thrust lowers the engine weight very considerably, which in turn permits increase of nozzle size so that greater propellent efficiency (higher specific impulse) can be obtained.

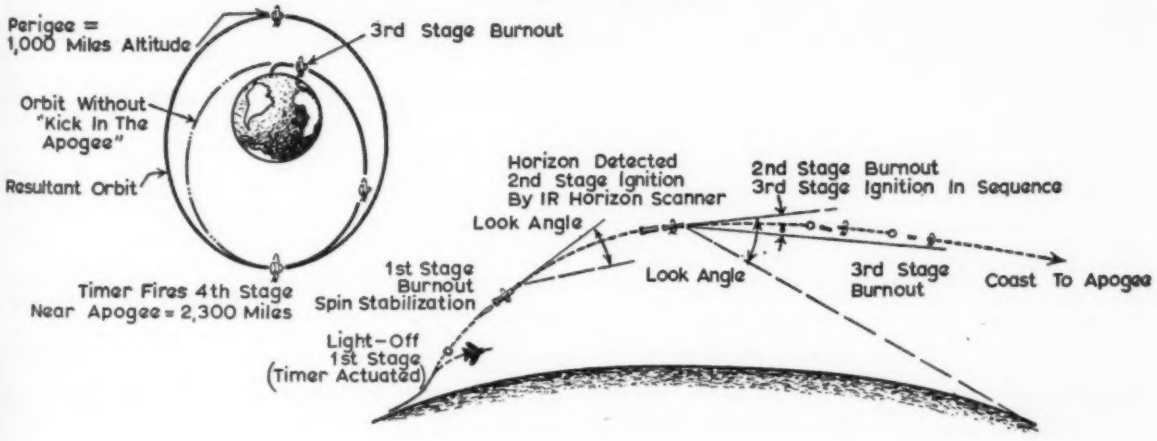
(ii) The continuous-thrust motor can and must be used to orient the stage so that a separate orientation system is unnecessary.

(iii) For reasons of (i) and (ii) the dead weight is reduced and the resulting increase in performance offsets the simply mathematically calculated loss in performance.

(iv) Light-up problems can be eliminated if desired.

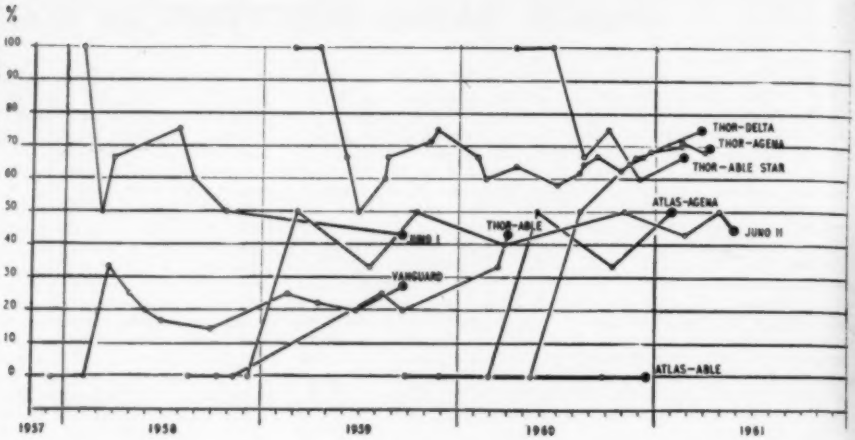
(v) Loss of cryogenic propellants due to solar heating, heat leakage, etc, can be avoided or minimized during the continuous-thrust programme (this is not completely possible during the coast period).

In the paper "An Economical Satellite Launching Technique for Conducting Radio Research in Space" by Mr John D. Nicolaides, the launching of satellites from aircraft was proposed. This diagram illustrates the launch sequence envisaged and the "kick in the apogee" firing of the fourth-stage motor to obtain the required orbit. Mr Nicolaides' views on space research, as presented at the Oxford meeting and on other recent occasions, are the subject of an article on page 39


Perigee = 1,000 Miles Altitude
3rd Stage Burnout
Orbit Without "Kick In The Apogee"
Resultant Orbit
Timer Fires 4th Stage Near Apogee = 2,300 Miles
Horizon Detected 2nd Stage Ignition By IR Horizon Scanner
2nd Stage Burnout 3rd Stage Ignition In Sequence
Look Angle
1st Stage Burnout Spin Stabilization
Look Angle
3rd Stage Burnout
Coast To Apogee
Light-Off 1st Stage (Timer Actuated)

Missiles and Spaceflight . . .

From the paper "Engineering Aspects of Satellites and their Launching Rockets" by Mr G. K. C. Pardoe of de Havilland Aircraft, this diagram indicates the reliability of various rocket launch vehicles, expressed as the percentage of success in placing payloads in orbit



(vi) If radar guidance is used, the very low acceleration permits very long smoothing times both during climb and cut-off so that radar guidance becomes very accurate and early correction of orbit is possible.

If a high perigee is required for the orbit for either the thrust-coast-thrust system or the continuous-thrust system, it is clear that during the injection phase the whole of the perigee altitude must be gained. Since for the sake of efficiency the climb angle must be small this inevitably means that:

(a) the end stage or stages must possess orbital or very-near-orbital velocity at the beginning of the climb, and

(b) the point of final injection must be a long way round the Earth from the point of launch.

For low orbits (300 n. miles) it can be shown that, down to 3,000 miles range, there is little change in rocket performance required; but for 5,000 n. miles circular orbits a sharp rise in rocket performance is required if the coasting phase is reduced below one-half of a revolution round the Earth.

This has two major effects; any guidance or tracking stations must cover a much larger flight path if no uncovered periods are to be left, and final cut-off has to be observed from an area remote from launch; and secondly, if a continuous-thrust system is used, extremely low values of motor thrust are necessary. The use of a very low thrust in the continuous thrust system has a very attractive feature in that it permits an even larger radar smoothing time than for injection into low orbits; thus even though the radar range is very much greater for the high-perigee orbits than for the low ones, the required angular accuracy of the radar used is virtually the same in order to achieve roughly constant velocity accuracy for the two classes of orbits.

Though the major portion of the speed needed for injecting a satellite into orbit must be given outside the atmosphere, in order to avoid too high aerodynamic heating effects, there are some potential advantages in using an aeroplane-like device for the first stage. The most obvious of these is the possibility of easier recovery and re-use of the first stage by making the first stage an aeroplane which can land in the normal way.

Employment of present-day aircraft is possible in this role, though the performance gains are not striking. An aircraft, say, with a high subsonic speed of M = 0.8, will only reduce the apparent velocity requirement of the rocket stages by 1,500 - 2,500 ft/sec. This reduction is larger than the actual velocity of the aeroplane stage by virtue of the altitude of the aeroplane at rocket launch (taken to be 40,000ft) with the consequential increase in specific impulse and the avoidance of much of the aerodynamic drag losses in the rocket stage.

The reduction in weight of the rocket stages required to be carried by the aeroplane as compared with an all-rocket vehicle depends a lot on the number of stages assumed and to some extent on orbit desired. If the aeroplane is counted as one stage, for the subsonic aircraft quoted above the total *rocket* weight may be about the same or even increased, but a 30-50 per cent rocket-weight decrease may be obtained by keeping the same number of rocket stages as before. An increase in the aircraft speed to M = 5 will materially improve matters, the weight reduction for an equal number of rocket stages being of the order of 65-75 per cent. The economies involved in the use of aircraft first stages need a lot more study.

In *Engineering Aspects of Satellites and their Launching Rockets*, Mr G. K. C. Pardoe of de Havilland Aircraft emphasized that most of these aspects were interdependent in a complex manner and some were far more advanced in technique than others. At present, he said, certain aspects seemed out of proportion, one example being the cost of producing a very modest amount of electrical power for a satellite. In a three-stage vehicle which might cost about one million pounds including the satellite, the solar cells accounted for "almost one-eighth of this sum."

There would thus seem to be a very good case, Mr Pardoe continued, for the development of more-efficient and cheaper electrical power sources for use in space. Low-weight high-reliability electronics, particularly that concerned with radio communication, would play a vital part in the evolution of space equipment for satellites and space probes and to some degree in the development of launching vehicles.

Control-system engineering would also be of importance in both vehicle and satellite design, particularly in the case of communication satellites. Here long life and high reliability coupled with low weight and power requirements were essential in a system destined to play a paramount part in world communication. This would undoubtedly be the first direct use of space by the world at large and would also be the first example of how this new space technology would yield large financial returns to support and justify the enormous investment which would be necessary to establish such new engineering techniques.

Details of experiments to be carried in the first Scout-launched joint US/UK satellite were given in four papers at the Convention: *The Use of Probing Electrodes in the Study of the Ionosphere* by Dr R. L. F. Boyd of University College, London; *Measurements of Solar Radiation* by Dr K. A. Pounds of Leicester University; *X-ray Spectrometer for Scout Satellite* by J. Ackroyd, R. T. Evans and P. Walker of Bristol Aircraft; and *Cosmic Ray Measurements in the UK Scout 1 Satellite* by Prof H. Elliott, Dr. J. J. Quenby, D. W. Mayne and A. C. Durney.

Other papers included *Radio Tracking of Artificial Earth Satellites* by Dr B. G. Pressey of the Radio Research Station; *Navigation Satellites with particular reference to Radio Observation* by W. A. Johnson of the RAE, Farnborough; *The Australian 210ft Radio Telescope* by Dr E. G. Bowen and J. P. Wilde of CSIRO, Sydney; *Radar Measurements on the Planet Venus* by L. R. Malling and Dr S. W. Golomb of JPL; *Radiation and other Environmental Effects on Satellites* by D R. Innes of Marconi; *Advantages of Attitude Stabilization and Station-keeping in Communications Satellite Orbits* by Dr W. F. Hilton and B. Steward of Hawker Siddeley Aviation; and *Proposal for an Active Communication Satellite System based on Inclined Elliptic Orbits* by B. Buss and J. R. Millburn of Hawker Siddeley Aviation.

GERMANY AGREES TO ANGLO-FRENCH PLAN

(continued from page 36)

tons can be put into a near-300 n.m. orbit, but half a ton can be placed in a 7,000-mile circle.

"As expected, the optimum third stage weight with liquid hydrogen/oxygen motor increases (due to the fact that this stage is now more efficient and should therefore be used to provide a larger fraction of the total velocity increment). The optimum third-stage weight (including payload) will be in the region of 7,000-8,000lb.

"Due to the increased third-stage weight it has been found that the third-stage thrusts should also be increased somewhat, compared with the case of the low-energy third stage.

"It is clear that the capabilities of the Blue Streak satellite-launching vehicle will cover an enormously wide variety of possible radio-satellite requirements; but, if it is found necessary to use it, still further development potential exists by converting the second stage to liquid hydrogen, first by itself and later with two stages above Blue Streak."

ROLLS-ROYCE AVON turbo jets

Rolls-Royce Avon powered Lightning supersonic fighters are in squadron service with the Royal Air Force

Rolls-Royce Avon engines in military and civil operation have flown more than 4½ million hours. The latest military Avons are fully supersonic engines both with and without re-heat. All Avons offer a long overhaul life coupled with low maintenance. They are in quantity production and are powering fighters, bombers and transports in service with the armed forces of seventeen countries.

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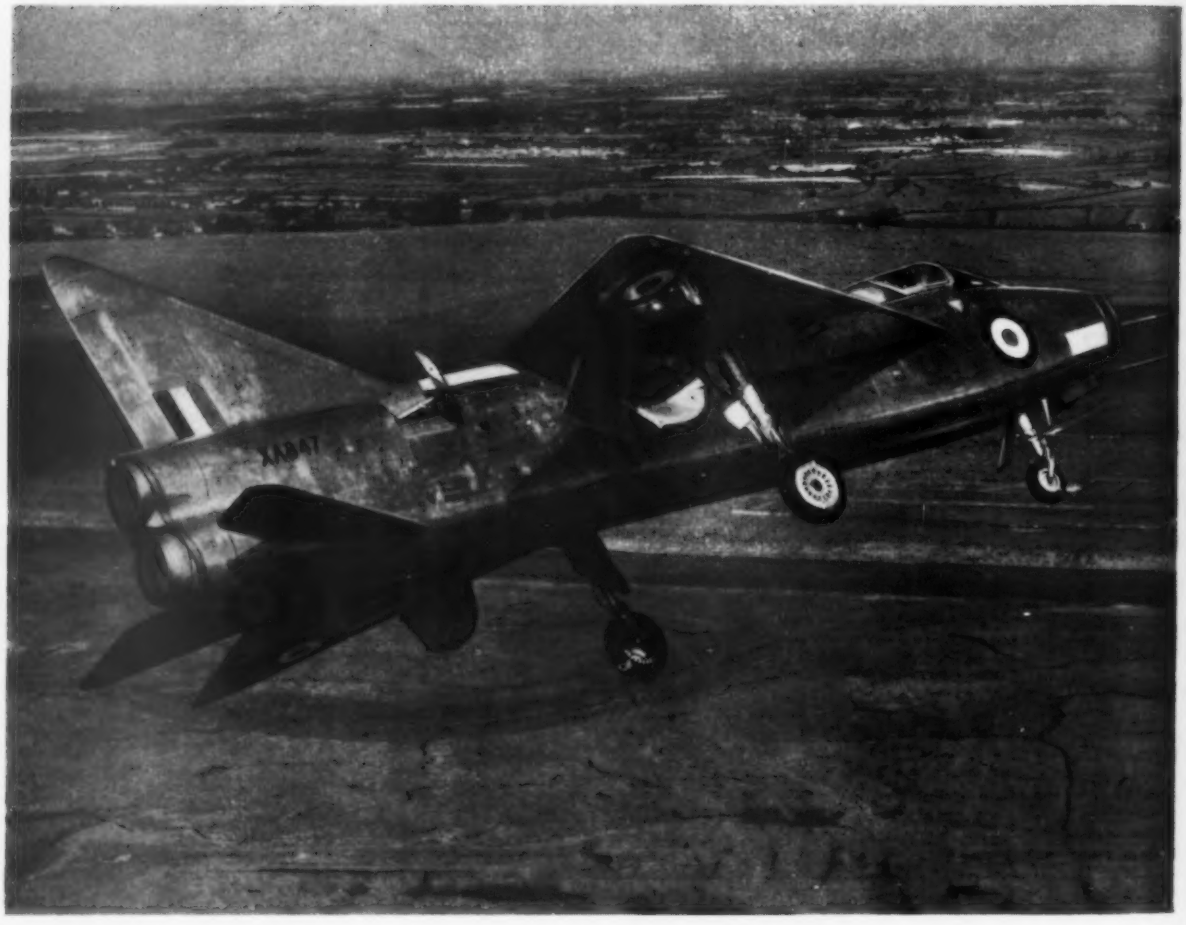


Dunlop tyres, wheels and brakes are standard equipment on the English Electric Lightning all-weather day and night interceptor now in service with the Royal Air Force. The braking system incorporates Dunlop Maxaret anti-skid units; and many components in the weapons system are also supplied by Dunlop.

DUNLOP

cm/av/11

Missiles and Spaceflight . . .

SPACE LAUNCHINGS THE CHEAP WAY

AN unorthodox American hit town last week. Holder of a senior defence astronautics appointment, yet sharply critical of the main lines along which his country's space programme is moving, this first-time visitor to Britain brought along a brainful of space ideas which he presented effectively to a variety of audiences.

He is Mr John D. Nicolaides, technical director for astronautics in the US Bureau of Naval Weapons, who began his programme here with an exclusive interview with *Flight*, talks at the Ministry of Aviation and Admiralty, and lectures before the British Interplanetary Society in London and the British Institution of Radio Engineers in Oxford. From the interview and the two lectures stems this account of Mr Nicolaides' space *credo* and US Navy developments.

Mr Nicolaides' main submission is that too much effort is being directed towards very large boosters and heavy spacecraft, and not enough towards cheap launching methods and simple, lightweight satellites. He suggests three ways in which satellite-launching costs and complication could be reduced: by launching (*a*) from aircraft, (*b*) from the surface of the sea, and (*c*) from submarines or surface vessels. These three techniques are represented by the US Navy's Caleb, Hydra and Sea Scout projects.

Illustrated for the first time on this page, Caleb is the current design of aircraft-launched, four-stage, solid-propellant rocket developed by the US Navy. It is an improved version of an original vehicle (based on clusters of modified underwater missiles) which in 1958 was used in a series of six attempts to place satellites in orbit from F4D Skyray aircraft.

Once bitten by the excessive advance publicity on the Vanguard programme, the US Navy was twice shy in talking about the 1958 aircraft launches, with the result that nothing was announced at the time. At Oxford last week, Mr Nicolaides commented: "The facts are, we might have placed a satellite in orbit — one tracking station did pick up the right signals at the right time."

Mr John D. Nicolaides, photographed at the British Institution of Radio Engineers' Convention in Oxford last week

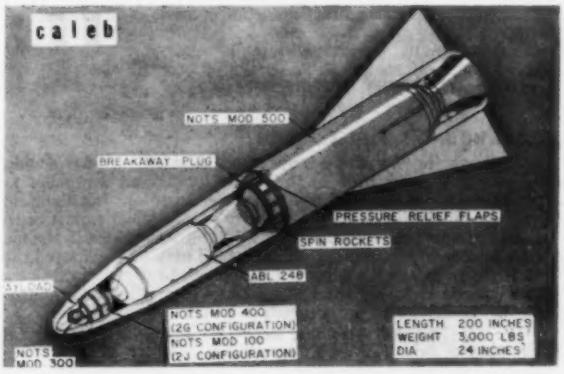
The redesigned Caleb has had two full-scale tests employing live first stages and dummy upper stages. Satellites up to 50lb in weight could be launched by this technique, and improvements in performance could result from the development of larger stages or the use of higher-performance aircraft. The cost of the vehicle is approximately $50,000 in small-lot production, and its weight is some 3,000lb.

Under Project Hydra, a number of promising tests have been carried out at the Naval Missile Center, Pt Mugu, California, in which the launch rockets have simply been floated vertically on the surface of the sea. The first attempt—completely successful—was on March 18, 1960, using a 4ft Hydra 1 wooden vehicle powered by a small aircraft rocket. Hydra 1A was "a novel vehicle," according to Mr Nicolaides, and his audience at the BIS lecture on July 5 will regard this as the understatement of the year. Depicted in the film on Hydra shown on that occasion was the Genie-boosted emergence from the deep of a 105ft telegraph pole, fitted with lead plates and fins. "Pole 1," to use its alternative designation, "became an effective test vehicle for the vehicle and its instrumentation."

The 46ft, ten-ton Hydra 2 followed, built for the NMC by Long Beach Naval Shipyard. The feasibility of operating Hydra rockets from floating dry docks was established. In this manner, it is claimed, rockets of almost unlimited size can be launched.

For satellite launching from ballistic-missile submarines, merchant ships or other vessels, the US Navy is forcefully presenting the case for Sea Scout, a highly attractive four-stage, solid-propellant launch vehicle based on Polaris (first and second stages) and the upper two stages of Scout. The development programme for this vehicle could easily be phased into the existing Polaris programme, it is claimed, without much modification to facilities or equipment. USS *Observation Island*, for example, could easily be adapted to handle Sea Scout in between Polaris firings.

As with Hydra, one advantage of Sea Scout is that it could launch a satellite into almost any desired orbit from almost any point on the seas. Sea Scout 1, 31ft shorter and 6,000lb lighter than the Scout vehicle, would carry payloads comparable to those of Scout, e.g., 106lb in a 460-mile orbit at 45° inclination. Using improved Scout upper stages, Sea Scout 1A would increase this payload to 179lb. The later use of Polaris A2 and A3 motors would further raise the figure to 270lb and 420lb respectively.



The redesigned rocket vehicle, designated Caleb, developed by the US Navy for aircraft launching of satellites following the initial series of six attempted launches in 1958

The techniques of Caleb, Sea Scout and Hydra, Mr Nicolaides believes, could be adopted and used successfully by Britain. Economical launching from the sea or air around the United Kingdom would result.

As far as the US Navy is concerned, it is practising what Mr Nicolaides is preaching by way of developing simpler and smaller satellites. The weight of the Transit navigation satellite, originally 265lb, will have been reduced to 75lb by next spring in spite of many improvements in the satellite's performance. A 98lb weather satellite has been proposed which would provide information direct to users all over the world instead of second-hand through a central data-collating centre as with Tiros. This could, it is claimed, be in use next year if the decision to go ahead were given.

In these thoughts, as in the Navy's contribution to the Project Anna geodetic satellite (a joint Army/Navy/NASA/Air Force programme could be operational in less than a year), the emphasis is on making practical and widespread use of space (both in scientific research and in applications such as navigation and weather study) without delay. In Mr Nicolaides, the US Navy has a worthy gospeller.

K. T. O.

One of the early rocket vehicles mounted beneath the wing of an F4D Skyray in the US Navy's aircraft-launch programme. It is possible that at least one satellite was injected into orbit by means of this technique

Bloodhound 2, subject of the order announced on this page, may not yet be illustrated, even though it is in the flight-test stage. Above may be seen Bloodhound 1s of a Fire Unit of the Royal Swedish Air Force; their behaviour led the Swedes to choose the Mk 2 weapon

Missiles and Spaceflight . . .

BLOODHOUND 2 FOR SWEDEN

The news on July 6 that the Royal Swedish Air Board has decided to purchase a production quantity of Bloodhound 2 missiles for operational use is the biggest fillip ever given to our missile industry. Not only is this easily the industry's largest-ever export order, valued at "many millions of pounds," but it was gained in the face of "intense competition"—a phrase which may be hackneyed, but which really means something when selling to a technically competent nation endowed with ample supplies of all foreign currencies. British Aircraft Corporation's statement follows.

"The Royal Swedish Air Board has placed with Bristol Aircraft Ltd, a company of British Aircraft Corporation, an order for the Bristol/Ferranti Bloodhound Mk 2 surface-to-air guided weapon system, which will play a key part in the future air defence of Sweden. No details of the size or value of the order—the first to be placed by an overseas government for Bloodhound 2—may be released, but it can be said that it is the largest contract yet placed for a British guided-missile system by a foreign government.

"Bloodhound 2 (which is already on order for the RAF) is a direct and logical development of the Mk 1 system, which was ordered by Sweden in September 1958 so that experience could be gained of the organizational and technical problems involved in adapting surface-to-air guided weapons to Sweden's air defence. Since 1958, the Royal Swedish Air Board has carried out intensive studies and evaluation work on technical and operational aspects to provide a basis for a decision to purchase an operational guided weapon system. It is as a result of this work that the Board has now placed an order for Bloodhound 2. In a statement issued in Stockholm, the Royal Swedish Air Board said: 'The adoption of Bloodhound 2 into the Swedish air defence system will complete our fighter defence and will give it higher efficiency since this guided-weapon system can be used against targets at the highest and lowest altitudes and gives a very high degree of readiness at a reasonable cost.'

"While closely resembling the earlier version in the external configuration of the missile itself, the Bloodhound 2 weapon system offers striking advantages in virtually every aspect of performance. It is also fully air-transportable. The new weapon system possesses greater range, greater lethality and greater operational flexibility. The most important single factor in these improvements is the use of continuous-wave radar guidance, developed in conjunction with the Ministry of Aviation by Associated Electrical Industries and Ferranti. Apart from enabling Bloodhound's radar range to be extended, the adoption of CW guidance had made it possible to achieve great lethality against all types of target down to very low altitudes, even in the face of highly sophisticated electronic countermeasures.

"Sweden became the first overseas country to adopt a British guided weapon for defence purposes when the order for Bloodhound 1 was placed two and a half years ago. Bloodhound 1 has also been adopted by the Royal Australian Air Force. Sweden's choice of Bloodhound has been made only after careful appraisal of every type of surface-to-air missile system available in the Western world. The contract was gained on the technical merits of the Bristol/Ferranti weapon system in the face of intense competition from manufacturers in other countries.

"An important factor in the negotiations with Sweden has been the technical and production strength of the consortium responsible for the design, development and manufacture of Bloodhound and the efficiency of the after-sales service and support provided on Bloodhound 1 by the manufacturing companies, each a leading specialist in its field. The individual companies concerned are Bristol Aircraft (who act as weapon-system manager); Ferranti Ltd (Wythenshawe and Edinburgh); Associated Electrical Industries and Bristol Siddeley Engines [whose advanced version of the Thor ramjet provides the increased range allowed by the CW radar—Ed]. During Bloodhound development, some hundreds of missiles have been fired, giving ample evidence of a formidable kill-potential under operational conditions. Bloodhound 1 is deployed operationally with RAF Fighter Command on a large scale, and RAF crews have for some time been carrying out regular firings of Mk 1 missiles under operational conditions at Aberporth."

GPO SPEAKS

On July 5 the General Post Office issued their first statement for publication on the subject of communications satellites. It reads (text slightly shortened):

"In studying problems associated with communications satellite systems, the following features have been taken as desirable targets: continuous 24hr service should be available for telegraphy and telephony between all ground stations provided in connection with the system; world-wide coverage should be provided in association with the existing cable and radio links; provision should be made for the satellites to carry about 1,000 telephone channels and one or two television links; the system should be capable of carrying the traffic in the minimum number of hops and the bulk of the traffic in one, i.e. by bringing into use only one satellite for the operation. With position-controlled satellites in an equatorial orbit a system consisting of 12 satellites would need to be put into orbit at between 7,000 and 8,000 n. miles, whereas for a system with 16 satellites between 5,000 and 6,000 n. miles might suffice.

"The launching of satellites for communications purposes is one of several important uses of a launcher based on the Blue Streak rocket, developed in the way envisaged by the European Launcher Development Organisation. In the White Paper on Post Office Prospects 1961-62 (Cmnd. 1327) reference was made to collaboration between the Post Office and the US National Aeronautics and Space Administration in tests of satellite communications across the Atlantic. The Post Office is providing an experimental ground radio station on the Lizard, Cornwall, in preparation for experimental tests of satellite communications next year. The tests will cover the transmission of speech, telegraphy, and television across the Atlantic."

Below is seen a portion of the Air Defence Missile Squadron at RAF Woolfox Lodge, beside A1 just north of Stamford. Woolfox is one of many Fire Units of Fighter Command now equipped with Bloodhound Mk 1, and scheduled to re-equip with the CW-radar Mk 2

SPORT AND BUSINESS

Private View

BY P. P. O.

THE King's Cup Air Race which is being held at Coventry this weekend has had a long and chequered history. When the cup was originally presented by King George V, the intention was clear. It was to be the prize for the premier air race of the year, and it was to be an air race which to sporting aviation was to be what the Fastnet Race is to ocean racing, the Grand National to steeplechasing, Le Mans to motoring, or the Derby to horse racing.

For a long time the King's Cup was confined to British pilots and aircraft—I think, perhaps, unwisely; foreign entrants in the other classic races of the year seem to add extra interest and to stir home competitors to still greater efforts.

The King's Cup is now in its 29th year, and still has a magic influence over its contestants insofar as, although there is no money prize, and the days are gone, perhaps never to return, when the winning of it was of so much advertising value that suppliers of petrol, oil, tyres, plugs, etc, would give large money bonuses if you could win with their aid, yet ask any British pilot what he most hopes to do, and he will tell you it is to win the King's Cup.

Fortunately, there is no sham amateurism in air racing. We race because we love it. An engraved pewter mug is prize enough, but if some kind soul should want to fill it with something else besides beer, no air racing pilot thinks he has lost social prestige if he or she says "thanks very much." Money prizes pay for more flying and engine repairs, and might even buy the baby a pair of new boots. No one could pretend that the donors of money prizes will get much in the way of direct advertising value out of it either, except, perhaps, the reputation of being a good sport. How much is that worth? Well, your guess is as good as mine!

★ ★ ★

The Cardiff races turned out to be all we had expected of them. The hospitality and organization, both at Panshanger and Rhoose, were excellent, and one heard scarcely a single grumble. It was a little difficult to get fed at Cardiff on Saturday, and some pilots in Class 3, whose race started at two, had to go off without lunch.

But with the co-operation of the weather, a very good time was had by all, and special thanks are due to the Royal Aero Club officials. Being an official at these races requires endurance, tact and good nature. Having marshalled and seen competitors off from Panshanger, you then have to get yourself as best you can by car or aeroplane to the other end, so as to turn up bright and smiling at Cardiff to marshal for the races next day. Inevitably, racing pilots are a little excited and strung up; so tact and good nature, which RAeC officials have in full measure, are needed.

Rhoose is a little complicated, as during the afternoon airliners are taking off and landing; so the local controllers have to be kept calm and happy. The gentlemen at Rhoose, who, like all experts, really know their job, were easy to get on with. They were so co-operative that one pilot suggested that they had earned the right to be called Air Traffic Assisters rather than that horrid word "Controller," so repugnant to the average Britisher. Our Rhoose friends actually seemed to want us to fly.

Everything went well. There were very few incidents apart from Bev Snook's exploding Spitfire, and curious ideas of height from some of the local talent, and we left Cardiff wishing we could have found everybody whom we would have liked to thank in the throng at the Glamorgan Flying Club. Not including, of course, the handicappers, because the harder these gentlemen work the less easy it is to win races or to think up new gimmicks to add a little unnoticed speed. They are really getting so expert these days that we poor pilots are forced into the position of having to fly really well, keep a first-class course, compute the wind very accurately, and really bend the throttle levers if we want to win races.

★ ★ ★

One of the more amusing sports which you can indulge in with your private aeroplane if you have radio, a licence to use it and plenty of time to spare on a fine afternoon is crossing the London Control Zone. Obviously you should only do this if you are intending to fly, say, from Redhill to Luton, or from Fair Oaks to Stapleford Tawney—doing a journey where you can show that going through the zone is a worthwhile saving in time and petrol. If this is so, it is almost your duty to go through the zone if only to make our controllers realize that the air does belong to all and not just the few.

My own experiences on a fine Friday morning are worth reporting, and went something like this. Me, in a trembling voice "London Approach, London Approach, this is Turbulent Golf Alpha Rose Juliet Zulu at 1,000ft over Leatherhead. Request VFR clearance through zone to Panshanger. Over." All very correct. Horrified silence from London Approach, so I repeat. Finally, "Juliet Zulu, we can't find you on our radar." Me: "Juliet Zulu. I am only a very little aeroplane." London Approach: "Turn to 090 and report over Ham Common. Maintain 1,000ft." Me, a little later, having done a little thinking and looking at the map: "London Approach, Juliet Zulu now over Richmond Park, approaching Ham Common, height 1,000ft. Request instructions." LA: "Juliet Zulu, do you know you are approaching a built-up area?" Me: "Yes, I require at least 1,500ft." LA: "Sorry, I can't give it to you." Me: "Shall I turn back?" LA: "Affirmative Sorry." So I turn back outside the zone again, and finally, by permission, cross the zone via Fair Oaks, Virginia Water, Windsor racecourse, etc, which is all open country and I knew to be the best way all the time.

Could we not, please, have a light-aeroplane corridor through the zone, along this route? You would enter the zone through the Fair Oaks corridor, cross Chobham ridges, Virginia Water and Windsor Great Park, over the Thames at Windsor Great Park, west of Slough, then turn in a north-northwesterly direction to the railway line and beyond. It is clear of all built-up areas and would save a great deal of time, besides being a lot safer than having to fly further west in the vicinity of Reading as we do now.

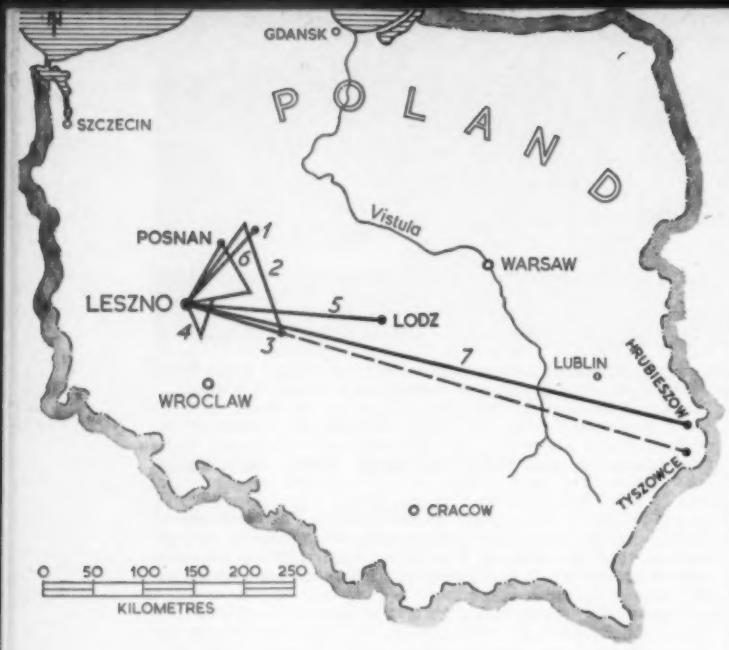
★ ★ ★

The rules for the 1961 International Business and Touring Aircraft Competition to be held at Oxford over the long weekend of July 28 have now been announced by the Royal Aero Club. The lessons learned at Shoreham last year have been carefully noted; there will be no taxying competition and no quick-starting marks, as last year—both tests rather fraught and of doubtful value. In their place there is the vastly important question of noise level. I am convinced that the biggest enemy the light aeroplane has to face, apart from the prejudices and fears of civil servants, is noise. It tires the occupants of an aircraft and it irritates and annoys people on the ground. Most modern light aeroplanes are now pretty good as far as ground noise heard from outside is concerned, but many have a longish way to go to reduce their inside noise. Undoubtedly, there are many people, particularly ladies and children, who would enjoy flying in light aeroplanes a lot more if they were quieter. But it is not an easy problem. You cannot have a hundred or more horses working away within a few feet of you, air rushing by, large fan or fans churning rapidly over, and not create a lot of noise.

The problem is how to blot it out, stifle it and prevent it from reaching our ears, or those of our passengers, in too-concentrated doses. If I were a young man starting a career, I think I should choose the interesting science of noise reduction. The motor-car people have solved it, and there is no doubt that we light-aeroplane people will solve it too and, when we do, much of the prejudice and dislike of aeroplanes which exists today in the minds of the general public will disappear. We shall find ourselves using our own aeroplanes more often and on longer trips; and the prospect of being able to whisper sweet nothings into the shell-like ears of our fair passengers in the privacy of a small aeroplane above the clouds opens a charming vista which might even cause a real boom in the sale of light aeroplanes.

"... the prospect of being able to whisper sweet nothings into the shell-like ears of our fair passengers in the privacy of a small aeroplane above the clouds"

C



Tasks set during the championships comprised (1) 204km out-and-return, (2) 300km triangle, (3) 184km out-and-return, (4) 104km triangle, (5) 195km race to Lodz, (6) 204km triangle and (7) 526km race to Hrubieszow. The dotted line shows the 525km goal flight to Tyszowce which gained British national women's goal and 500km speed records for Mrs Welch on June 20

Poland's National Gliding Championships

BY ANN WELCH

THIS year's Polish championships, held at Leszno during June 4-18, were the largest competitions yet in which all the competitors were flying the same type of glider. Unlike the aircraft, the pilots were varied. In addition to 40 Poles, there was one pilot each from France, Rumania, Britain, Bulgaria, Italy, Hungary, Switzerland, Jugoslavia and Austria, and two each from Russia, Czechoslovakia and East Germany, 55 in all.

The practice days were spent in getting used to the 15-metre Mucha Standard. These were production versions of the prototype with which Adam Witek became standard-class champion in the 1958 World Championships. The Mucha has been improved in various ways, and is a highly serviceable and efficient production aircraft. The foreigners who had not previously flown the aircraft soon became delighted with it, and the only complaint that came from some pilots was that, although the seat of the Mucha was standardized, their own was not. This problem was invariably remedied in the usual way—by surreptitious addition of blankets.

June 4, the opening-ceremony day, was also a contest day; the speeches were made with commendable dispatch, and shortly afterwards the gliders were launched. Unlike the British system, in which the pilots can select their launch-time, the gliders are arranged in rows of eight (the positions being the result of a ballot) and wait there until the organization deems it time to start. The gliders are then towed up to 700 metres just as quickly as the tugs can manage it.

It is possible to get a faster launch rate than with the British system but there is the risk that, if a mistake is made in the selection of the starting time, there may be wholesale landings back on the field, or good soaring weather may be wasted. There is something to be said for both systems, but theirs could be improved if the initial ballot positions were advanced each day by, say, one row of gliders, instead of having a new ballot prior to each contest day. This would obviate the risk of some pilot continually drawing a disadvantageous starting position.

The task on this first day was an out-and-return of 204km to the north-east, with a near-headwind of 30km/hr. During the morning thunderstorms developed and for some time remained clear of the track, but not for long enough. Only 18 pilots, including two foreigners, got back, most of them having climbed to more than 10,000ft and then glided the last 30-40 miles home. Starting a little earlier would have resulted in more pilots completing the task.

Then the retrieving started. This is done almost entirely by aerotow, usually with Polish-built Russian Po-2 biplanes, which made a most distinctive noise reminiscent of a motor-boat plodding across a harbour. It is quite unbelievable what patches of ground (I won't say fields) their very competent pilots whisk the gliders from. The system is that the glider pilot acts as controller for the operation. He must check that his field is at least 250 metres long, with an obstruction-clear slope thereafter at the take-off end of not less than 1: 30. If the field is not big enough, but there is a better one not far away, he must move the glider. This may well involve the foreigner in some complicated sign language and pidgin-anything-he-can-think-up in order to arrange for a horse to pull the glider, only to find that the farmer wishes to know the weight of the aircraft in kilograms in order to calculate the number of horses necessary! Having found himself a suitable field, the pilot places the glider crosswind in such a position that the tug shall touch down ten metres ahead of the nose (even if this means putting the glider into the next strip or across a ditch), and parallel to the wings. In due course a Po-2 waffles into the field, the glider is hooked on, and the combination clambers out and bumbles off home.

If the field is very small a shorter rope is used, down to four metres if necessary. With this sort of length, the take-off is assisted because the glider is virtually blasted into the air by the slipstream. The Po-2 is a remarkable aeroplane. In order to fly one in Jugoslavia some eight years ago, I was given the briefest briefing ever. An expressive Serbian hand indicated climb, level flight, and glide, accompanied only by the words "One hundred kilometres." I peered at the instruments, all inscribed in the Russian alphabet, and asked "Benzine?" to be answered by "Enoff." With that I had to be satisfied.

On June 5 Josef Dankowski declared a 300km triangle, starting with a dead beat into a rather strong wind, and anticyclonic air. Twenty-two pilots failed to reach the first turning-point although they were in the air for three and four hours. For those who managed to get on to the second leg, life was rather easier, although nearly one-third more landed on this leg because of the lateness of the hour. Only eight pilots managed to get back to Leszno. The effect of this day's flying on the marks was to put all those pilots who failed to reach the first point beyond any possibility of winning. They included Makula, who came second in the last World Championships.

On the 300km day the longest leg in time, and by far the most difficult, was worth only just over 100 points, the second leg some 320 points and the last and easiest leg nearly 500 points, not including speed marks.

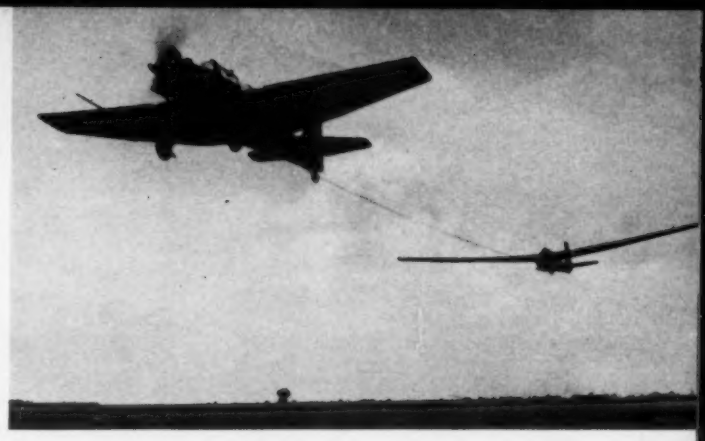
The third day, June 6, produced similar weather, and an out-and-return race to Ostrow (184km total) with the same dead beat to windward as on the previous day. Twenty-eight out of 55 pilots got back, but again nearly one-third of the competitors failed to reach the turning-point in spite of flying for many hours fighting against the wind.

Again the value of marks to distance differed greatly on the two parts of the flight. To avoid this problem in the British Nationals, we normally set out-and-returns *across* the wind, particularly if it is strong. The Polish reason for setting them into wind is that any cloud-street formation can be utilized to obtain a higher average speed. Although this is true, I do not think that, in strong winds, the effect on the marks warrants it.

After such an active start to the competitions, it was quite pleasant to have a rest day. However, the non-soaring weather continued, and after three days of excursions, films, museums, and swimming, enjoyable as they were, everyone was looking forward to getting into the air again.

At briefing on June 10, we were told that the task was a 100km triangle, and that it was necessary to get going quickly as a cold

Ann and Lorne Welch, respectively team captain and pilot on this occasion, are third and fourth from the right in the front row. The line-up includes also Italian, Austrian, East German and Polish pilots and crews



Take-off from Leszno: a Junak tug aircraft towing a Mucha Standard during the championships. Length of tow-rope is 65ft

front was due to arrive in the early afternoon. The triangle was to the south, with the last leg returning parallel to the front.

I had a grandstand view of the final stages of this race from a Jaskolka at a height of 1,200 metres. All but eleven competitors streamed over the line like coloured minnows, and covered the airfield with a gay pattern as 30 gliders landed within a few minutes of each other, and not long before the front. When I saw lightning I reckoned it was time for me to land as well—this was no kids' stuff growing all around. It was brakes out all the way down from 1,500 metres and, if I flew at less than 110km/hr, I promptly started going up again. We just managed to pile everything into the hangar as the rain started. Marian Gorselak, who brought Poland into third place in the 1956 World Championships in France, continued to maintain top position, though pressed hard by Josef Pieczewski.

Now came no less than four consecutive days with the weather deteriorating steadily into typical West Country rain. We felt depressed, water was lying visibly in the fields and ditches, and with the end of the competition only three days away we almost started to pack. It was therefore a pleasant surprise on the morning of June 15 to find that the dilatory front had finally started to move clear, and that sensible-looking anticyclones were developing over France and the Azores. The sun glimmered occasionally through the stratus, and we even felt satisfied to see that most of the available isobars were densely packed into the British Isles.

A 195km race downwind to Lodz was declared, not without some organizational misgivings. Normally they would not have been

Polish pilot Pelagia Majewska during briefing. The award to her of the FAI Lilienthal Medal was announced, and celebrated, during the contest

tempted into flying in such feeble conditions, but the Polish visitors to our championships, having concluded that "stratus flying" was a British national institution, felt encouraged to try it also.

The results were even more encouraging; 23 pilots reached the goal, but although Pieczewski made the fastest time, he was not able to dislodge Gorselak from the lead.

On June 16 a 200km triangle to the north-east was set, and this time there was no dead-beat leg. Gorselak, sadly, came to roost at the first turning-point, but the runner-up got back, along with 22 others, and as a result came into the lead.

I was allowed to plod along in the Jaskolka after the competitors had gone, and managed to reach the second turning-point at Posnan, getting home smartly behind a Junak tug whose pilot was quite clearly in a hurry. Fortunately the air was now calm.

The last competition day was June 17 and the organizers were working themselves up into a frenzy of decision. For a long time now they had wanted to set either a 500km straight race or a 500km triangle. Today was their last chance, but they were not sure if the weather was good enough. The forecast was all right, but the day was late in starting. We all sat by our gliders, ready to go, and watching the cloudless sky for the first sign of cumulus. Dankowski declared Hrubieszow, 526km away, as goal, but said that he would change it if no clouds had appeared by eleven. At 10.50 one or two tiny wisps showed themselves and the race was on—the first 500km race ever to be set in gliding championships. The Muchas were off in just over 30 min, and then there was a pause while they cleared away and before I took off in the Jaskolka.

It was a courageous gesture on the part of the organizers to let me go at all, since to send 55 gliders on a 500km race was only the beginning. They next would have to locate and retrieve these gliders from the far end of Poland in time for next day's prize-giving—if possible. To do this gigantic job, all the adjacent aero-clubs would be called in to help with drivers, trailers and tugs. The competitors had all left the site by 11.45—late for a 500km attempt—but I did not get clear until about 12.15, having been subjected to the most frustrating and infuriating torture at the beginning of any serious soaring flight—the attentions of a photographic aeroplane. The wretched thing buzzed round and round like a hornet, the two-rope sting in its tail flailing along too close for comfort. I lost my thermal then took twenty minutes to get going again.

The day was a triumph of faith (and I suppose not a little hope) on the part of the organization. Two pilots (one Polish, Luszpinski, and one foreign, Zejda of Czechoslovakia) reached the goal; one more, Wielgus, was only 2km short; and a total of 23 pilots achieved 500km or over. Fifty pilots, myself included, exceeded 350km, and Lorne was only 10km short of the magic 500.

The retrieving was even more difficult than the organizers feared, since more gliders than expected had landed in too-small fields. There was a bottle-neck in trailers, even to get the gliders to nearby collecting-point airfields for multiple-tow returns. It was late the next day before I was collected from my remote village and linked up at Lublin, but hopes of getting back to Leszno in order to catch the train to England had faded. I finally went by car with three of the 500km pilots on the eleven-hour trip back.

Lorne also took two days to return, but unfortunately had to continue back to England at once. I was persuaded to remain one more day, and woke up exhausted after the previous three days' perambulations, missing-out on meals and sleep, etc, to be told that the weather was excellent, and back to the Pripet Marshes I must go. In vain did I say I was too tired; I was forcibly driven into the air. Eight hours later, I was indeed back in East Poland, with a 525km goal in my pocket. But that is another story.

I was not able to find out much about the prizegiving except that it took place, although competititors were rather thin on the ground. Pieczewski, Popiel and Gorselak were first, second and third respectively, and the top visiting pilot was Mestan of Czechoslovakia (fourth). In spite of the poor weather during the middle part, the championships were most successful. The Polish organization of such events is among the best in the world, combining as it does sheer down-to-earth competence with courageous task-setting, and the creation of a most friendly and enjoyable atmosphere.

All the visiting pilots were involved in exchanges with Polish pilots, and, so that the Poles going to other countries could learn something about them, the exchange pairs were installed in the same huts. This also meant that the visitor to Poland had someone to help him. The language problem was not great, although most conversations were carried on in two languages. The Poles, Jugoslavs, Russians, Czechs and Bulgarians can all comprehend each other, and the second language varied between German and English, with French an occasionally useful third. One had of course to be prepared for unexpected phrases, such as "a completely unalimentated cumulus," or reference to an aeroplane as being "very good for the schleppness."

Poland is a beautiful country to fly over, in spite of the almost frightening flatness of the central plain. Navigation is easy, for their half-million air maps are good. They have one great problem in their competitions which we, thank goodness, do not have in ours, and that is the necessity to get control authority for every flight. This must make task-setting a nightmare, as often preparations must be made the previous night before adequate weather information is available. The extent of this preparation was obvious when one found it impossible ever to talk to one's friends in the organization as they were permanently on the telephone.

Some 70,000km were flown by the gliders on a total of seven contest days. Three-quarters of the retrieving was done by air, mainly out of fields that neither pilot had seen before. It is a tribute to the exceptionally high quality of all their pilots that, in about 170 field-towing sorties, only one aeroplane was slightly damaged. As a visitor to such events it is nice to be able to have faith in the locals, and at Leszno one felt that the standard of aircraft serviceability, operational efficiency, and flying discipline and ability was as high as one could wish for.

Lightning F.1A of No 56 Sqn

LIGHTNING

"THE BEST FIGHTER IN THE WORLD"

BRITISH aeronautical technology has always advanced steadily, in parallel with that of other major nations. Nevertheless, for financial reasons, our programmes involving actual combat aircraft have been forced to progress in leaps and jumps, rather than in a series of orderly steps. Thus, the RAF had to take in one leap the transition from the Meteor 8 to the Hunter; and today young, first-tour Hunter pilots are converting to the 1,500 m.p.h., missile-armed, all-weather English Electric Lightning intercepter. This advance is an even greater one, and it is giving Fighter Command a defensive weapon system of tremendous effectiveness.

When a nation is constrained to attempt large technological jumps, lead-times become even longer than the inevitable minimum of some six years for any advanced type of aeroplane. In fact, the history of the Lightning can be traced back 13 years, to the days when the Vampire F.3 was taking its place alongside the Meteor F.4, and Britain had officially abandoned the idea of producing a piloted supersonic aeroplane. But during 1948 this decision increasingly appeared to be an error of the first magnitude, for the Bell XS-1 had exceeded M1 the previous October and the transonic F-86 Sabre was about to enter USAF squadron service.

In fact, the Ministry of Supply picked up the threads of manned supersonic flight late in 1947, and started preliminary discussions with manufacturers. These talks eventually led to Experimental Requirement 103, calling for an aeroplane capable of research at transonic and low supersonic speeds.

In 1957 this journal said, "By 1949 such manufacturers as English Electric and Fairey had given the problem a great deal of thought, and both companies submitted proposals. Fairey's aeroplane became the record-breaking F.D.2, virtually a minimum supersonic envelope for a pilot, engine and fuel."[1] The article went on to discuss the English Electric aeroplane, and further details of the early history of both research aircraft prefaced our full description of the F.D.2 the following year.[2]

From the outset, English Electric's design team, then led by Mr W. E. W. Petter, were convinced that there would eventually be an Air Ministry requirement for a supersonic fighter, and they planned their E.R.103 submission—which was known as the P.1—to facilitate its eventual conversion to fulfil an operational role. In the event they were quite right, and specification F.23/49 called for a supersonic day fighter in the summer of 1949.

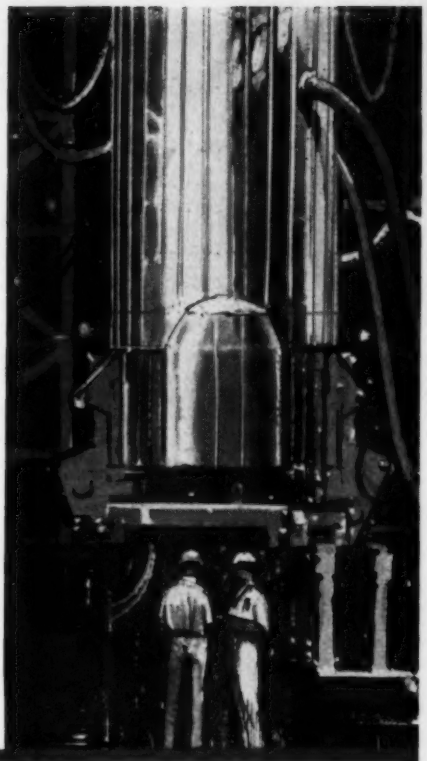
By this time English Electric had received a contract for two P.1 aircraft, plus a static-test airframe, against the original research requirement. The configuration chosen[3] was one of striking appearance and, although it has been adopted by no other manufacturer, it offers a unique combination of advantages. It was very early appreciated that two engines would burn less fuel than one large engine with a high degree of reheat, and would also permit control duplication. It was not long before the decision was taken to mount the pair one above the other. The fact that both then lay on the aircraft centreline eliminated all engine-out asymmetry, and by tucking the upper engine down behind the lower engine it was found that twice the thrust of a single powerplant could be had for barely 1.5 times the frontal area. This gave a slab-sided body, on which the wing was mounted above the centreline.

Aerodynamically the P.1 is a considered compromise between the demands of the upper and lower parts of the performance spectrum. Bearing in mind that the original requirement was for a very modest supersonic performance, it was calculated that the optimum wing would have a leading-edge sweep of 60°, allowing a relatively generous depth and a leading edge of substantial radius. Nevertheless, the then-popular delta shape was rejected on the grounds that it would give inadequate control in the pitching plane, especially at extreme altitude and in the approach. The P.1 was given a tailplane, and this was mounted low on the fuselage in order to avoid the pitch-up moments which have since been suffered by fighters with horizontal tails mounted high on the fin.[3] The trailing edge of the wing was cut back at almost the same sweep-angle as the leading edge, and the ailerons were mounted transversely at the tips (i.e., joining the leading and trailing edges). All controls were fully powered.

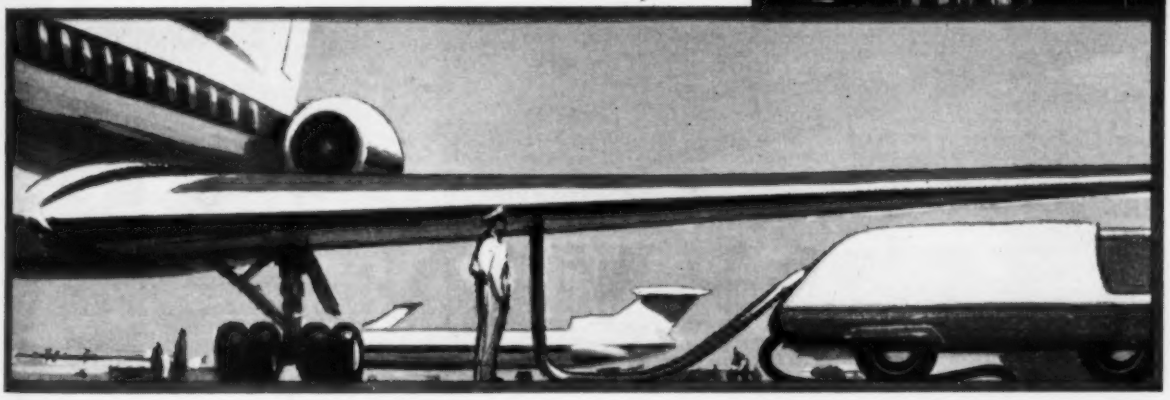
Other design choices were a direct pitot intake in the nose (adequate for the range of Mach numbers originally envisaged), split flaps, airbrakes on either side of the propelling nozzles, and a rather unusual landing gear in which the long main legs were pivoted near the geometric centre of each mainplane and folded outwards, and the nosewheel retracted forwards and turned to lie flat beneath the air duct. For obvious reasons, there was little or no volume available in the fuselage for fuel, but the wing was designed as an integral-tank box between the spars.

Although the immediate commitment was merely the manufacture of an experimental aircraft, English Electric and the Ministry of Supply were faced with the need to undertake a very large programme of research before much metal could be cut. The company decided to finance the construction of a turbojet-powered tunnel, initially commissioned in 1949 as a high-subsonic installation but modified the following year to have a slotted 1ft-sq working section for transonic operation. This was the first privately owned transonic tunnel outside the USA and with it English Electric perfected new methods of instrumentation for Mach numbers between 0.6 and 1.1. In 1954 an even greater expenditure was authorized for a tunnel powered by two Nene engines, with an 18in slotted working section capable of being replaced by solid liners for M1.4, M1.6 and M1.7.

Further investment was made in a complete simulated P.1 cockpit and flying-control system. A comprehensive analogue computer was incorporated, and the arrangement had six degrees of freedom in order to explore behaviour fully. With this apparatus a



Down go fuelling costs with the new A.W.E. fuel coupling



A new comprehensive range of aircraft mounted coupling units for aviation fuelling is now available ex stocks at A.W.E.

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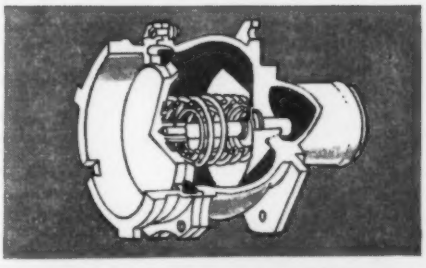

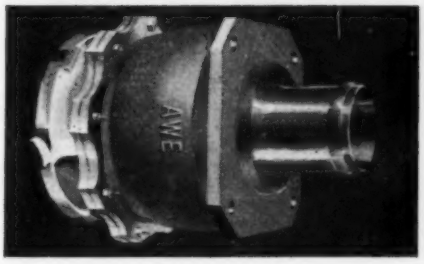

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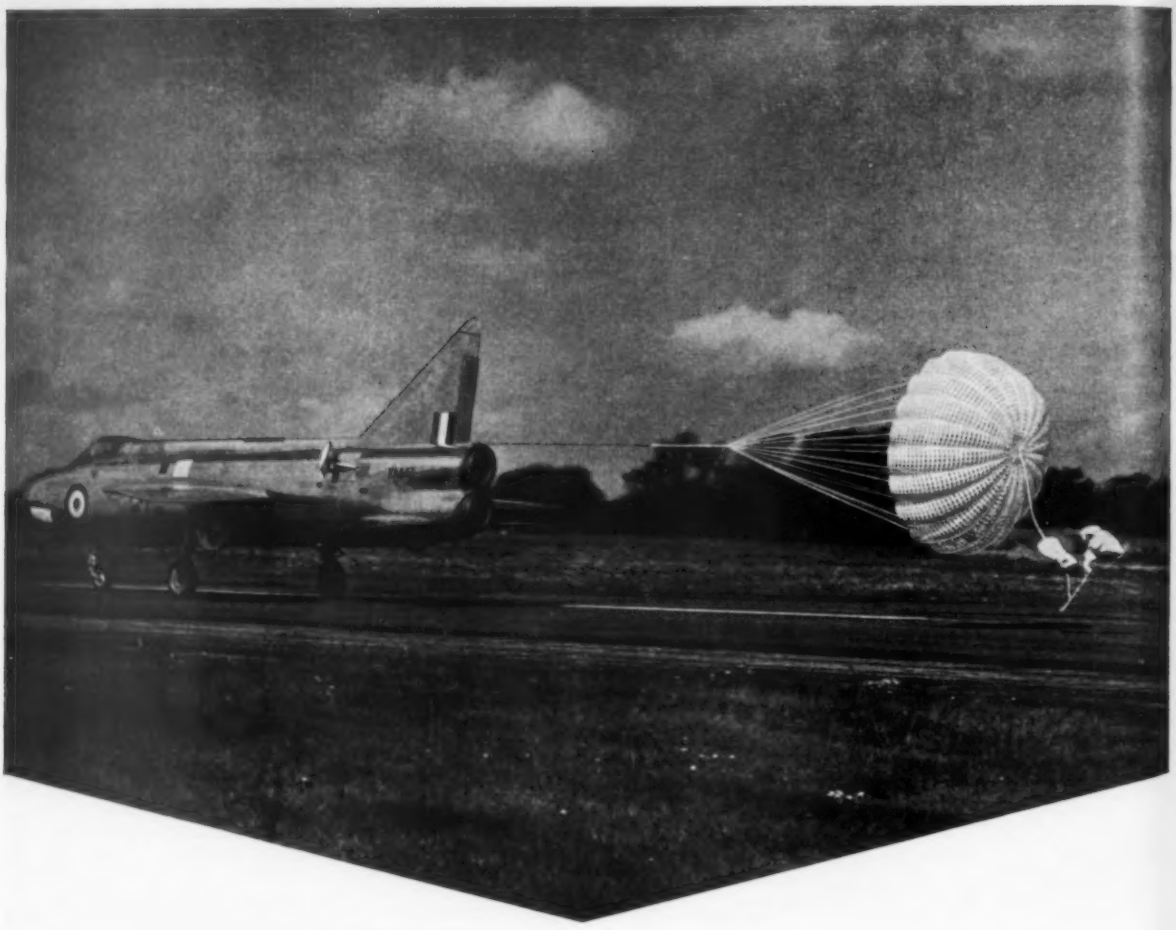

IRVIN

IRVIN Parachutes were chosen by English Electric Aviation Limited for their all-weather, supersonic day and night fighter now in Squadron service. The characteristic short landing-run of the 'Lightning' is achieved by the use of IRVIN Landing Brake Parachute type L.B.2 Mark 1.

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LIGHTNING...

complete investigation was made into flutter characteristics, and many hours were spent in perfecting the q-feel system.

Further research support was provided by the SB.5 aircraft built by Short & Harland under MoS contract and flown in December 1952. This machine, which is still providing useful data for other programmes, served to confirm the predictions of the tunnel results and establish the general soundness of the aircraft configuration. It was particularly useful in exploring low-speed handling, and one noteworthy contribution which it made was the discovery that, instead of having conventional wing fences, the P.1 could control its boundary layer by axial saw-cuts in the leading edges—"ingrowing fences," as one engineer called them. Lighter than fences, and offering less drag, the saw-cuts were flown on the SB.5 and proved perfectly satisfactory. On the P.1 they were later reduced in size, and made to incorporate a vent for the tankage.

The first P.1, bearing the serial number WG760, was completed in the spring of 1954. It looked quite unlike any previous aeroplane; this journal saw fit to describe it as having "all the shapeliness of a suitcase," and remarked on the absence of a double-shock intake and rear-view canopy. The two 7,500lb Armstrong Siddeley Sapphire engines were not yet fitted with reheat, but WG760 had ample thrust to lift off the runway at Boscombe Down on August 4, 1954, and from that moment Britain had the makings of a supersonic fighter.

Pilot on that first mission was Mr R. P. "Bea" Beamont, then chief test pilot of the English Electric Company and now deputy chief test pilot of British Aircraft Corporation Ltd, of which English Electric Aviation is a part. Without being aware of it, he let WG760 slip through the once-feared sound barrier on the second flight, and within a few days he was throwing the new prototype round the sky with all the verve which had made his Canberra demonstrations so famous. No other supersonic aeroplane in the world could be flown in the same manner, and on this invaluable basis of superb handling English Electric proceeded with the design of their fighter for the RAF.

It should be mentioned at this point that Mr Petter left the company in 1950, and virtually the entire design and development of the P.1 rested ultimately on the shoulders of Mr F. W. "Freddie" Page, who at that time was chief engineer of the Aircraft Division. His team has at all times been based at the company's R & D establishment at Warton aerodrome, some ten miles west of Preston, Lancashire, where the main airframe plant is located. An additional production facility is at Samlesbury airfield, roughly the same distance to the east of the city, and further large airframe components are produced at Accrington.

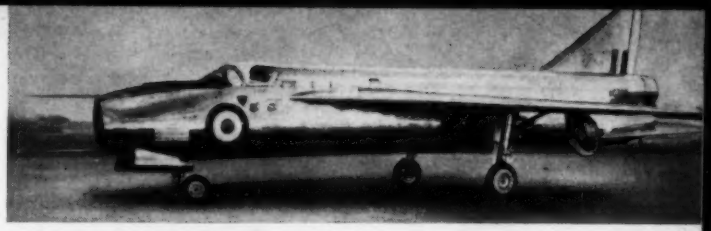
Production-type jigging was used to construct the first three airframes, one of which was the static-test specimen. The second prototype, WG763, flew in July 1955. Unlike its sister-ship it was fitted with a pair of Aden 30mm guns, together with some operational equipment and a ventral tank (or the rocket pack for boost propulsion which was under consideration). Experience with WG760 had shown that leading-edge flaps were an unnecessary complication, and on WG763 they were fixed. Another change was the addition of rudimentary reheat, although the fact that the nozzles were matched to the reheat condition reduced the cold thrust to only about 4,200lb.

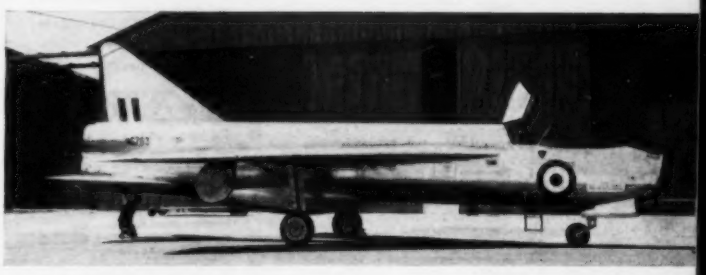
Throughout 1956 the two prototypes bore the whole load of full-scale flight development, and in addition to their many other tasks WG760 was fitted with a new wing with extended and cambered outboard leading edges. This modification[1] was found to reduce drag in the subsonic cruise condition by up to 20 per cent, although it caused a mild increase in drag at supersonic speeds which could be compensated for by a small increase in engine thrust. In the event it was decided not to incorporate it in the fighter at that time.

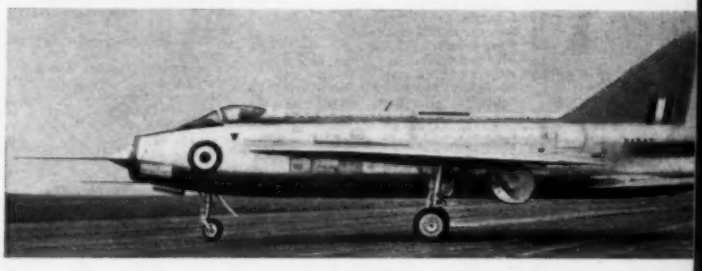
This fighter became known in the design office as the P.1B, the two research aircraft being re-styled P.1As. Even before the latter machines flew, the analogue simulator and tunnel models had indicated that the basic aeroplane was an outstanding flying machine, and an exceptionally suitable vehicle around which to plan a combat weapon system. The term "weapon system" is used advisedly, for by this time both the manufacturer and Ministry of Supply were well aware of the belief that this US-evolved concept is the only practicable manner in which a modern military aeroplane can be produced to a reasonable time-scale. The concept was applied a trifle late for the P.1B programme to take the fullest advantage of it, but this was the first project of this magnitude attempted in Britain, and most things had to be learnt the hard way.

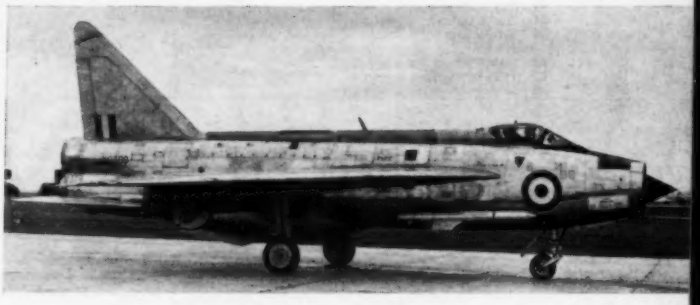
While the P.1A continued to provide a foundation of actual experience,[4] the team under Mr Page rapidly evolved a completely new aeroplane, for the P.1B differed from the P.1A considerably in appearance and completely in systems and equipment—in fact, the only thing left unaltered was the proven aerodynamic shape and control system. Installed thrust was practically doubled by a change to an advanced version of the Rolls-Royce Avon with a variable

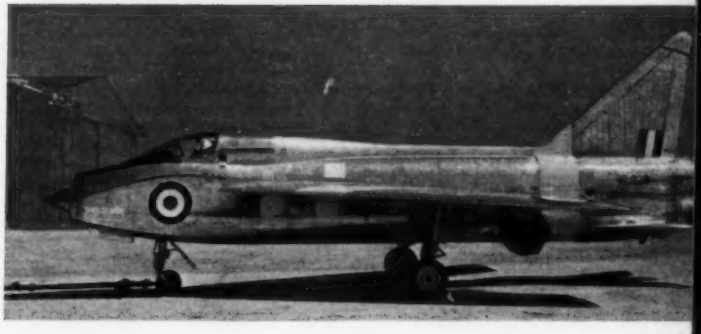
(*Continued on page 48, after double-page drawing*)











Major stages in the evolution of the operational weapon; from the top: the first P.1A, immediately before flying at Boscombe; the second P.1A, with belly tank and internal equipment changes; the first P.1B, immediately after roll-out; one of the 20 development aircraft, with enlarged fin, guns and dummy Firestreaks; and the first T.4 two-seater again immediately after roll-out on to the apron at Warton

LIGHTNING...

General

Fuselage

1 Kelvin Hughes 91in pitot boom
2 Intake bullet housing Airpass radar
3 Top bullet spigot access
4 Nosewheel bay in lower bullet-strut
5 Engine air duct
6 Bullet alignment adjustment
7 Supplementary intakes (those in bullet stalk locked shut in production aircraft)
8 Duct flattens below cockpit
9 Air to lower (No 1) engine
10 Air to upper (No 2) engine
11 Top gun longeron
12 Lower longeron
13 Gun shroud structure
14 Two gaseous-oxygen bottles
15 Oxygen charging connection
16 Nose jacking point
17 Attachments for cockpit ladder
18 Magnesium-forged canopy top frame
19 Shoot-bolts
20 Canopy latches
21 Inflatable canopy seal
22 Front pressure bulkhead
23 Rear pressure bulkhead
24 Side pressure walls
25 Access to ammunition tanks, autopilot computers, fuel-contents amplifiers, Tacan T/R, master reference gyro, emergency battery
26 Armament bay between frames 13 and 22
27 Multi-bolt joint between front and rear fuselage at frame 25
28 Wing/fuselage front main attachment
29 Wing/fuselage rear main attachment
30 Multi-bolt attachment plate
31 Stress-bearing hatch under No 1 engine
32 Oil filler access
33 Engine drains
34 Hatch attachment bolts
35 Stress-bearing hatch over No 2 engine
36 Hatch-lifting lug
37 Fin spars bolted to frames
38 Jetpipe trunnion access panels
39 Light-alloy honeycomb sandwich structure
40 Dielectrically isolated fin tip
41 Braking-parachute compartment
42 Parachute streaming anchor and jettison unit
43 Streamer cable spring-clipped around rear lip
44 Main pack
45 Vane-type auxiliary parachute
46 Cables actuating internally retracting doors
47 Tail bumper
48 Tie-bars across four rear frames
49 Reheat-jetpipe mounting rails

Wing

50 Front and rear spars of hockey-stick form
51 Wing halves bolted through forged centre rib
52 Main wing-box skin machined from 0.2in light-alloy plate
53 T-section intermediate-spar booms pre-attached to skins
54 Rib/spar structure inside box bolted in Warren-girder lattice
55 Detachable leading-edge sections
56 Compass unit in starboard leading edge
57 Aerodynamic sawcut slots
58 Navigation lights
59 Corrugated - sandwich skin in wheel bays

A Air conditioning

A1 Ram intake to cabin-air heat exchanger at duct bifurcation
A2 Cold-air unit and water boiler on starboard flank
A3 Water header tank
A4 Water extractor
A5 Conditioned air duct to cockpit
A6 Cockpit pressure test connection

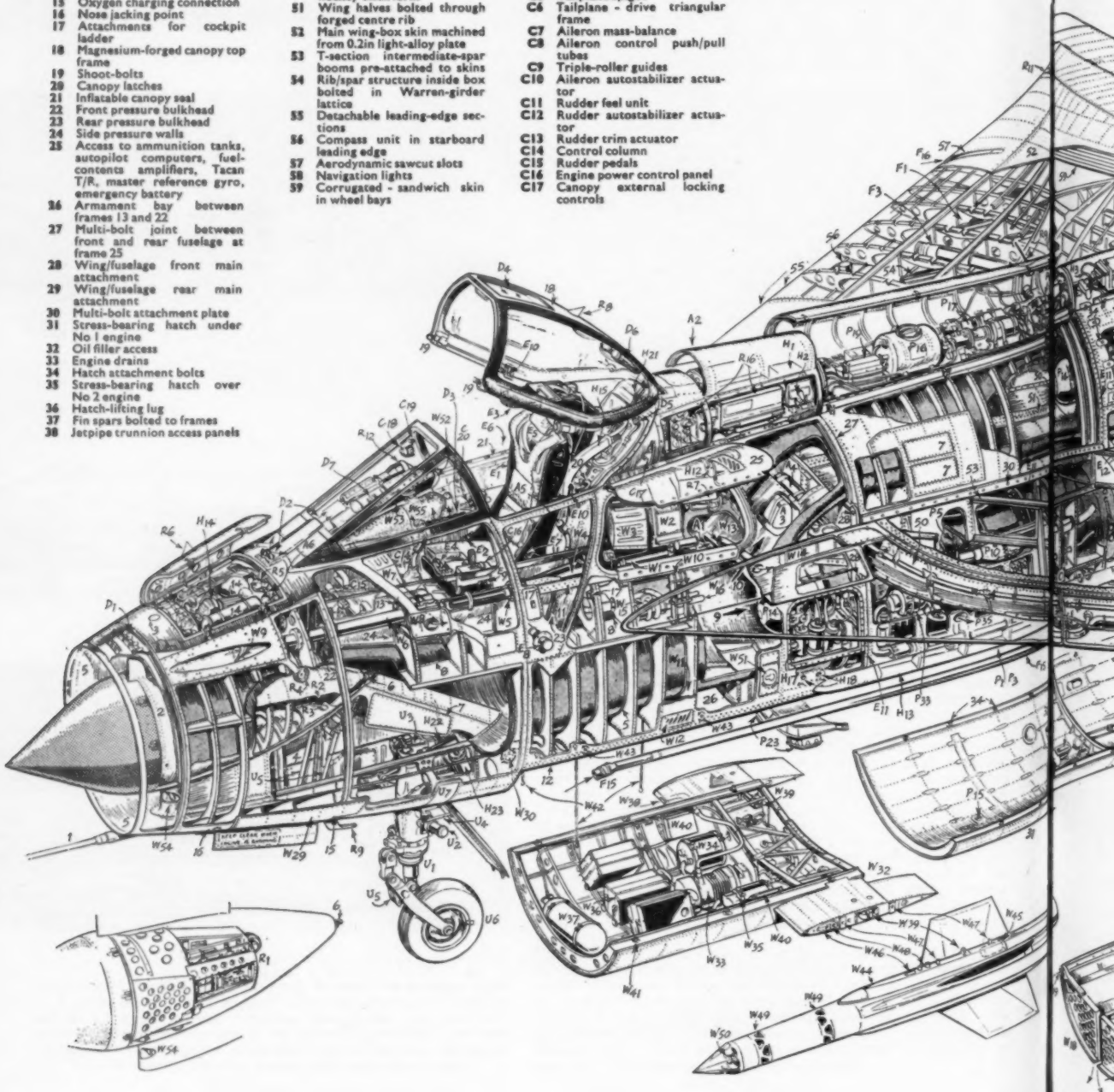
C Flying controls and cockpit

C1 Aileron p.f.c.u. (powered flying-control unit)
C2 Rudder p.f.c.u.
C3 Tailplane p.f.c.u.
C4 Ultra amplifiers (tailplane and autostabilizer system)
C5 Tailplane spigot
C6 Tailplane - drive triangular frame
C7 Aileron mass-balance
C8 Aileron control push/pull tubes
C9 Triple-roller guides
C10 Aileron autostabilizer actuator
C11 Rudder feel unit
C12 Rudder autostabilizer actuator
C13 Rudder trim actuator
C14 Control column
C15 Rudder pedals
C16 Engine power control panel
C17 Canopy external locking controls
C18 E2B standby magnetic compass
C19 "Canopy unlocked" warning lights
C20 High-intensity cockpit lighting
C21 Starboard airbrake shown open
C22 Plain flaps

D De-Icing

D1 Hot-air anti-icing around intake lip
D2 Rain dispersal duct
D3 Side-panel demisting ducts
D4 Canopy top-panel demisting ducts
D5 Demisting-air flexible bellows
D6 Canopy-air desiccant packs
D7 Embedded electro-thermal windscreen elements

E [illegible]
E1 Martin 4S ejection [illegible]
E2 Para[illegible] connection[illegible]oxygen, air-ventilated anti-g)
E3 Face [illegible]
E4 Aldis screen-[illegible] Grip
E5 Parcel [illegible]
E6 Survival pan
E7 Hand [illegible] override
E8 Emer[illegible] ram intake
E9 Emer[illegible] jettison handle
E10 Canopy [illegible] units and struts
E11 Fire[illegible]
E12 Hand[illegible] (tit-anium)
E13 Grav[illegible] suppression bottles

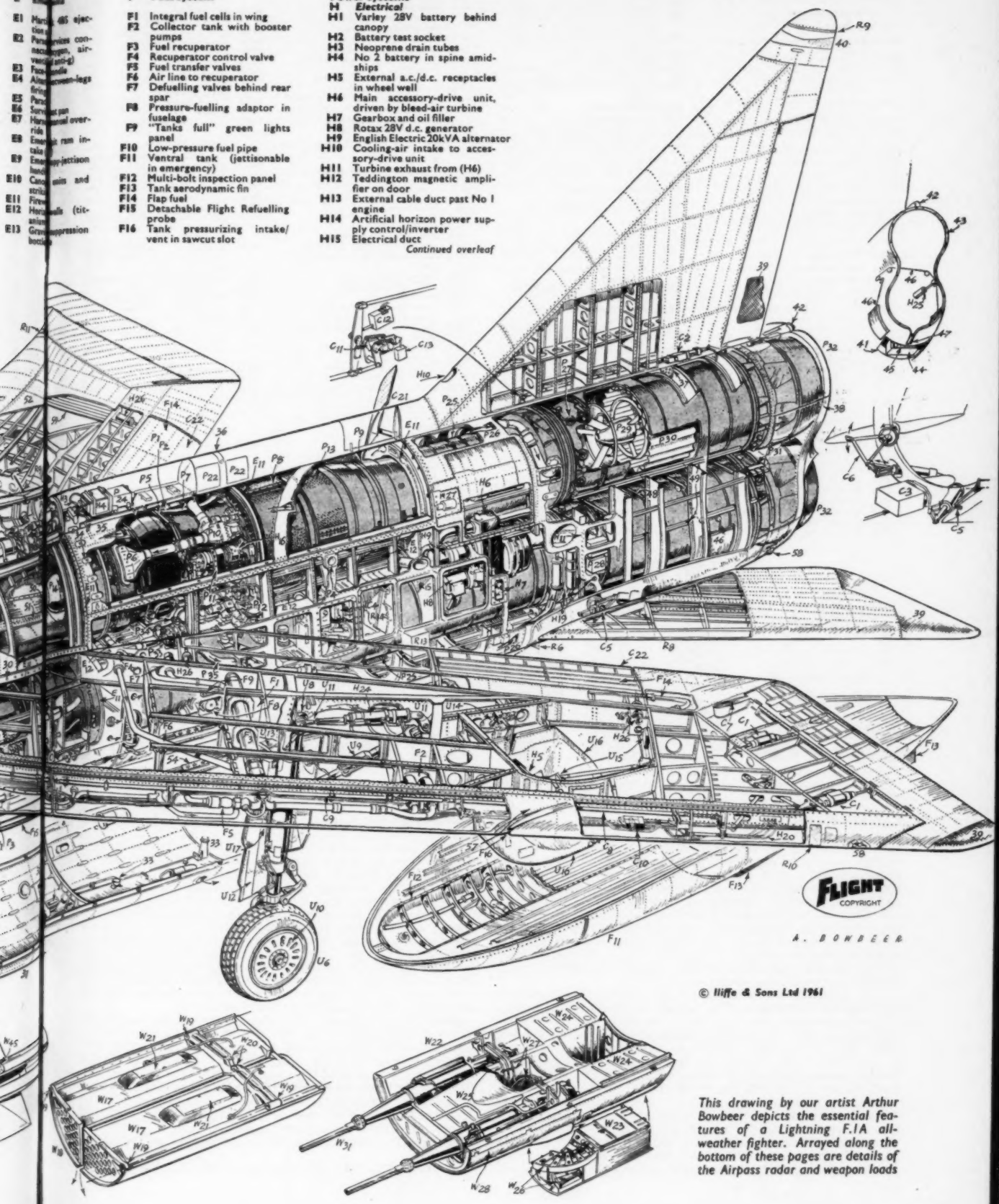


E Engines
E1 Martin-Baker 4BS ejection seats
E2 Pneumatic services connections (oxygen, air-ventilation, anti-g)
E3 Face blind handle
E4 Aimer's seat between-legs fairing
E5 Parachute
E6 Sighting gyro gun
E7 Harness manual overrides
E8 Emergency ram intake
E9 Emergency jettison handles
E10 Canopy units and striker
E11 Firewall
E12 Hood rails (titanium)
E13 Gravity compression bottle

F Fuel system
F1 Integral fuel cells in wing
F2 Collector tank with booster pumps
F3 Fuel recuperator
F4 Recuperator control valve
F5 Fuel transfer valves
F6 Air line to recuperator
F7 Defuelling valves behind rear spar
F8 Pressure-fuelling adaptor in fuselage
F9 "Tanks full" green lights panel
F10 Low-pressure fuel pipe
F11 Ventral tank (jettisonable in emergency)
F12 Multi-bolt inspection panel
F13 Tank aerodynamic fin
F14 Flap fuel
F15 Detachable Flight Refuelling probe
F16 Tank pressurizing intake/vent in sawcut slot

Power systems
H Electrical
H1 Varley 28V battery behind canopy
H2 Battery test socket
H3 Neoprene drain tubes
H4 No 2 battery in spine amidships
H5 External a.c./d.c. receptacles in wheel well
H6 Main accessory-drive unit, driven by bleed-air turbine
H7 Gearbox and oil filler
H8 Rotax 28V d.c. generator
H9 English Electric 20kVA alternator
H10 Cooling-air intake to accessory-drive unit
H11 Turbine exhaust from (H6)
H12 Teddington magnetic amplifier on door
H13 External cable duct past No 1 engine
H14 Artificial horizon power supply control/inverter
H15 Electrical duct

Continued overleaf



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This drawing by our artist Arthur Bowbeer depicts the essential features of a Lightning F.1A all-weather fighter. Arrayed along the bottom of these pages are details of the Airpass radar and weapon loads

Continued from previous page

Power systems

Hydraulic

H16 Two Integral pumps on each engine
H17 Accumulator group (air-brakes, ailerons 1 and 2, rudder, wheelbrakes) and nitrogen containers
H18 Aileron accumulator pressure gauges
H19 Tailplane accumulator, pressure gauge, and nitrogen bottle
H20 Aileron hydraulic supply
H21 Canopy actuator ram
H22 Nosewheel jack
H23 Shimmy-damper accumulator
H24 Main-undercarriage jack
H25 Braking-parachute door jack
H26 Flap actuator jacks
H27 Airbrake synchronizing unit

P Powerplants

P1 Two Rolls-Royce Avon reheat turbojets
P2 No 1 engine-change unit below wing
P3 No 2 engine-change unit above and behind wing
P4 Main mounting trunnions
P5 Front mounting points
P6 Anti-icing bleed air to inlet guide vanes
P7 Compressor section
P8 Combustion section
P9 Turbine section
P10 Compressor air-bleed gate valve and ducts
P11 External wheelcase driving tachometers, hydraulic pumps and other units
P12 Fuel control system
P13 Refrasil heat shrouds
P14 Plessey LTSA. 70 starter
P15 Starter exhaust
P16 Avpin tank (3 gal)
P17 Plessey pump units
P18 Solenoid valves
P19 Voltage regulators
P20 Starter control unit
P21 HF igniter units
P22 No 2 engine igniter units
P23 No 1 engine igniter units on duct access panel
P24 Elliott throttle actuator amplifier
P25 Intermediate jetpipes
P26 Reheat cooling air
P27 Reheat fuel spray nozzles
P28 Reheat igniter units and plugs
P29 Flameholder
P30 Corrugated inner liner
P31 Air-driven nozzle actuator
P32 Variable propelling nozzle
P33 Lucas bleed-air turbopump for reheat fuel (No 1 under front spar, No 2 inboard of flap)
P34 Bleed-air pipe to reheat pumps
P35 Turbopump exhaust

R Radio and Radar

R1 Ferranti Airpass I radar fire-control in bullet
R2 Bullet conditioning-air heat exchanger
R3 Outlet from heat exchanger into wheel bay
R4 Radar ground cooling air coupling
R5 Bullet conditioning-air desiccant pack
R6 Tacan aerials
R7 Tacan T/R unit
R8 IFF aerials
R9 Communications aerials
R10 Localizer aerial
R11 Glide-path aerial
R12 AI display unit
R13 Glide-path receiver
R14 IFF T/R unit
R15 IFF coder unit
R16 Communications T/R unit

U Undercarriage

U1 Dowty (formerly British Messier) forward-retracting nose gear
U2 Shimmy damper and centring unit
U3 Downlock frame
U4 Door linked to leg
U5 Wheel-door operating cams and linkage
U6 Tubeless tyre
U7 Access to nose-leg pivot
U8 Main-leg compound-angled hinge axis
U9 Radius rod, breaks inwards
U10 Dunlop multi-disc brake
U11 "Floating jack" directs pressure against top of leg, and to radius-rod bellcrank
U12 Leg door fixed to leg
U13 Forward fairing flap
U14 Wheel-door jack and sequence valve
U15 Door latch linkage
U16 Wheel-well door
U17 Landing lamp on leg

W Weapons

Upper guns

W1 Two Aden 30mm guns
W2 Ammunition tank: port gun
W3 Ammunition tank: starboard gun
W4 Front mounting cone
W5 Front mounting socket
W6 Blast tube
W7 Sleeve over viewing aperture (used during alignment)
W8 Blast-tube air-pressure relief duct
W9 Upper gun-port detuner
W10 Used-link chute
W11 Used-link compartment
W12 Louvred emptying door
W13 Used-case delivery tube to
W14 Case collector box in wing
W15 Gun-purging valve and delivery pipes (see also deicing)
W16 Engine bleed-air to (W15)

Rockets

W17 Microcell glass-fibre retractable rocket-launchers
W18 24 x 2in rocket tubes in each half
W19 Hinge points on outer edge
W20 Jack attachment point
W21 Control and fuze unit

Lower guns

W22 Twin-Aden gun-pack
W23 Ammunition tank
W24 Spent-case compartment
W25 Used-link compartment
W26 Belt feed guides
W27 Used-link chutes
W28 Gun access hatch
W29 Cover plate over lower gun ports in fuselage
W30 Gun-purging air pipe-connector
W31 Detachable barrels

Guided Weapons

W32 Firestreak pack, and pylons
W33 Alternator: hydraulically driven from aircraft system
W34 Control unit
W35 Condenser unit
W36 Launching sequence unit
W37 Air bottle for missile cooling
W38 Ram-air for alternator cooling
W39 Explosive ejector-release units and attachment point on shoe
W40 Electrical distribution boxes
W41 Six attachment bolts
W42 Hoisting points and cables
W43 Winch brace-sockets
W44 Missile launching shoe
W45 Rear fairing carrying refrigerant cylinder
W46 24-way electrical connection
W47 Locating dowels and sockets
W48 Hot and cold air connections
W49 Fuze "windows"
W50 Seeker cell in segmented glass nose.

General

W51 Armament safety-break panel (ground arming link: rocket launchers ground extend/retract switch)
W52 Airpass pilot attack sight
W53 Attack-sight recorder
W54 G90 camera in "stalk"
W55 Weapons trigger and camera-button on control column.

MEN BEHIND THE LIGHTNING

THE HON H. G. NELSON, *chairman, EEA*

LORD CALDECOTE, *managing director, EEA*

F. W. PAGE, *chief executive, EEA*

W. SHORROCK, *general manager, EEA, Preston*

WG CDR R. P. BEAMONT, *deputy c.t.p., BAC*

LIGHTNING...

reheat system, while complete rearrangement of the fuselage enabled much operational equipment to be tucked away inside. Plain flaps were fitted, and made to house additional fuel; the increased flight performance made a double-shock intake essential, and the *ad hoc* conical centrebody formed an ideal location for the AI radar; the lower intake strut supporting the centrebody allowed the nosewheel to retract forwards without turning; to reduce tailplane buffet, the airbrakes were changed in shape and moved ahead of the fin[5]; and the cockpit was raised to provide a better view and lead to a dorsal spine fairing providing a readily accessible location for a whole row of components and services.

Even before the first P.1A flew, in 1954, it had been decided to purchase three prototypes of the fighter. The first of these, bearing the serial number XA847, was flown from Warton by Mr Beamont on April 4, 1957. The speed of sound was exceeded on the first flight, and from the outset the new fighter was a real winner.

As already noted, the P.1 can be regarded as the first British weapon system. It also broke new ground in that its development was facilitated by the ordering of a substantial batch of aircraft each allotted a specific development task. After discussions with Mr Duncan Sandys, then Minister of Supply, the number to be ordered was ultimately agreed at 20 (excluding the P.1As and three P.1B prototypes). These aircraft began to come off the line in 1958, and were duly assigned to work in such fields as powerplants, general handling, guns, guided weapons, radar, autopilot, ILS coupling and blind-landing systems, and special duties at the A & AEE, CFE and RAE.

Pilots at the latter establishments formed an essential link between the manufacturer and customer, and shortly before the first flight of XA847 the Air Ministry sent Sq Ldr James L. Dell to Warton on detachment to the company's flight operations department (he is today the company's chief test pilot). More than 30 pilots flew P.1Bs during 1958, and as the weeks went by the flight trials began to embrace such items as gun firing, missile compatibility, radar performance and some of the still-secret parts of the operational equipment. The first of the 20 development aircraft was XG305 and during 1958 both this aircraft and two successors built with the small fin were fitted with the new fin of increased height and area which had been discovered to be necessary due to the higher speeds and greater weapon loads of the future fighter.[6]

Steadily the number of P.1B flights approached the total of 500 previously set by the P.1As. But not all the work was based at Warton. Other manufacturers had their own supporting programmes, one of the largest being Ferranti's work on the Airpass radar, for which purpose the complete system was mounted in a Dakota and a Canberra B.8 test bed[7]; de Havilland Propellers (now de Havilland Aircraft) had their own enormous programme for the development of the Firestreak air-to-air missile,[8] and dummy hot rounds were fired from a special rig at RAF Valley, Anglesey, to ensure that the rocket flame would not damage the ventral tank or tailplane.

On October 23, 1958, at a ceremony at the RAE, Farnborough,

Marshal of the Royal Air Force Sir Dermot Boyle, then CAS, named the new fighter the Lightning. He said:[9]

"I am confident that in the aircraft we see before us—sleek, powerful, and aggressive—the Royal Air Force has a winner. Through the very closest co-operation and enthusiastic team work, with the skilful assistance of principally Rolls-Royce, Ferranti and de Havilland Propellers, English Electric have produced a weapon system which is going to be second to none in the world . . . it is no secret that our American friends who have flown it have paid enthusiastic tribute to its qualities—and in particular to its outstanding climb and acceleration, as well as its remarkable inherent stability, without autostabilization, at its operating altitude and speed . . ."

The first production order for the Lightning F.1 was placed in November 1956. The number of aircraft was later estimated[10] at about 50. A further order, for a quantity then believed to be 100, was announced on April 28, 1958, and further orders have been placed since. Throughout, the aim has been to ensure continuity of production, following answers to virtually all the immediate problems standing in the way of CA Release of the complete weapon system. Even the humble prototype XA847, not fitted with autostabilization, achieved notoriety late in 1958 by exceeding M2 and maintaining the magic figure at the minimum reheat setting. On this occasion the aircraft was fitted with ventral tank, missile pylons and a heavy load of instrumentation, and Mr Beamont described its handling as "eminently satisfactory."

By early 1960 production F.1s completely filled the relevant part of the manufacturer's facilities at Preston, Accrington, Samlesbury and Warton, development aircraft and production machines were in the final stages of their service trials at the Air Fighting Development Squadron at CFE, and plans were being completed for the issue of the aircraft to RAF Fighter Command. Although the Lightning is an all-weather fighter, it was decided that it would initially be issued to Hunter day-fighter squadrons, and the first unit to be chosen was No 74, at Coltishall, Norfolk. We visited this squadron earlier this year, when it was working up to operational status, and were able to confirm at first hand that relatively inexperienced pilots could convert to the Lightning with no trouble at all.[11] Much of the credit for this must go to the Lightning Conversion Unit, which planned the ground programme and first ten flying exercises, to the General Precision Systems simulator, in which every pilot undergoing conversion has "every emergency in the book thrown at him"; and to English Electric's servicing school at Warton—and, for that matter, to the instruction courses run by such major contributors as Rolls-Royce, de Havilland and Ferranti.

To be precise, some of the aircraft now in service with Nos 74, 56, 111 and other squadrons are actually designated Lightning F.1A, but the differences are not markedly evident and are restricted on security grounds. Yesterday the Ministry of Aviation allowed a visit to Lightning production for the first time, and in this issue we are officially authorized to present a description and cutaway drawing of the existing squadron aircraft.

The Lightning F.1A

Structurally the Lightning is completely conventional, the ruling materials being high-strength light alloys (largely DTD.687 and L.73, and extrusions or forgings of DTD.683). Many of the forgings bearing concentrated loads are of high-tensile steel, titanium alloys are used in firewalls and elsewhere in the rear fuselage, and the rudder and the tips of the fin, tailplanes and ailerons are of metal honeycomb-sandwich construction. Assembly of the airframe is generally effected by a variety of types of rivet or bolt, there being little bonding and no welding.

An unusual feature is that the division between the front and rear sections of the fuselage is as far ahead as Frame 25, in line with the front of the wing box. Aft of the nosewheel well the lower part of the front fuselage is removable, the forward section (Frames 13-22) being the weapons bay. The door beneath the lower engine is just aft of the weapons bay and the engine is removed downwards through this aperture, while the upper engine is removed upwards through a similar door in the rear fuselage.

Port and starboard mainplanes are constructed in separate jigs, and then joined on the centreline prior to being offered up between the front and rear fuselage sections. When the fuselage and main wing box form a complete structure the leading edges, flaps and ailerons are added. All primary loads are borne by the main box, which has five spars generally parallel to the leading edge and 17 ribs, all largely built up in Warren-girder fashion. The upper and lower skins are basically 0.2in thick, that in the upper surface incorporating three stress-bearing detachable panels to provide access to the interior. The latter is sealed against fuel leakage by bonded rubber extrusions, nylon thread and compressed rubber blocks.[12]

Construction of the leading edge is quite conventional, and the innermost portion is employed as a collector box for empty cases from the upper guns. The self-sealing, integral-tank flaps are made in inner and outer portions, the complete unit being hung on three simple hinges and operated by hydraulic jacks at the inboard and outboard ends. The ailerons have aluminium-honeycomb tips with a large horn balance, and mass-balance weights in the horns and at each inner end. Construction of the tail unit can be seen clearly from the main drawing, each half-tailplane having an I-section spar, lap-jointed to a steel forging which forms the attachment pivot rotating in a double ball bearing and double tapered-roller bearing. The two airbrakes each open forwards under the thrust of a single hydraulic jack.

Manufacturer of the landing gear is British Messier, now part of the Dowty Group. When the gear was designed, nearly ten years ago, it was an extremely advanced concept to meet a most demanding requirement; but today the most remarkable fact about its design is its conventionality. The only unusual feature arises from the fact that each main leg retracts outwards into a wing with an extreme degree of sweep. Accordingly, the wheel doors are hinged inboard of the wells which they cover, and the wheel has to turn through some 60° on its leg to lie flat when retracted.

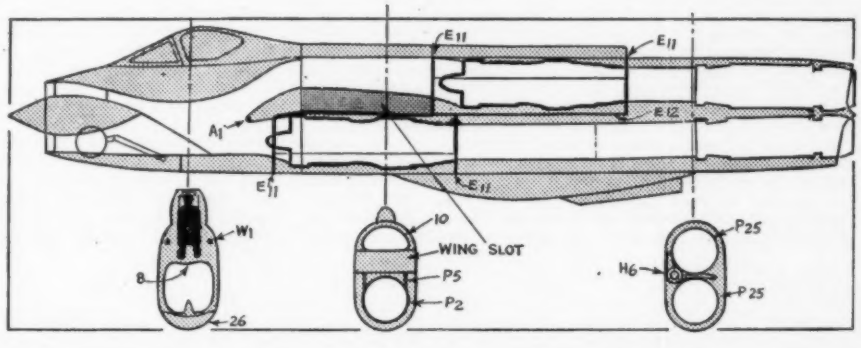
The need to accommodate the entire main unit inside the outboard part of the wing meant that the wheel, tyre and brake had to be very thin, while high-tensile steel appeared essential in order to achieve requisite strength in the long leg. Dunlop wheels, tyres and multi-cylinder plate-type brakes are fitted, with a Maxaret anti-skid system. The nose unit is fitted with a hydraulic shimmy-damper, which centres the wheel during retraction. A steerable nosewheel is to be introduced.

Mention should also be made at this point of the braking parachute. This is a 16ft ribbon canopy, by Irving Air Chute, housed in a box with hydraulically operated doors, immediately beneath the lower-engine reheat nozzle. The canopy is pulled from its box by a vane-type auxiliary chute, and the streamer cable fleets away from the box, tail bumper and spring clips around lower and upper nozzles, until the full drag load is imparted just beneath the trailing edge of the rudder. Provision is made for jettisoning, and for automatically freeing the canopy in the event of inadvertent streaming.

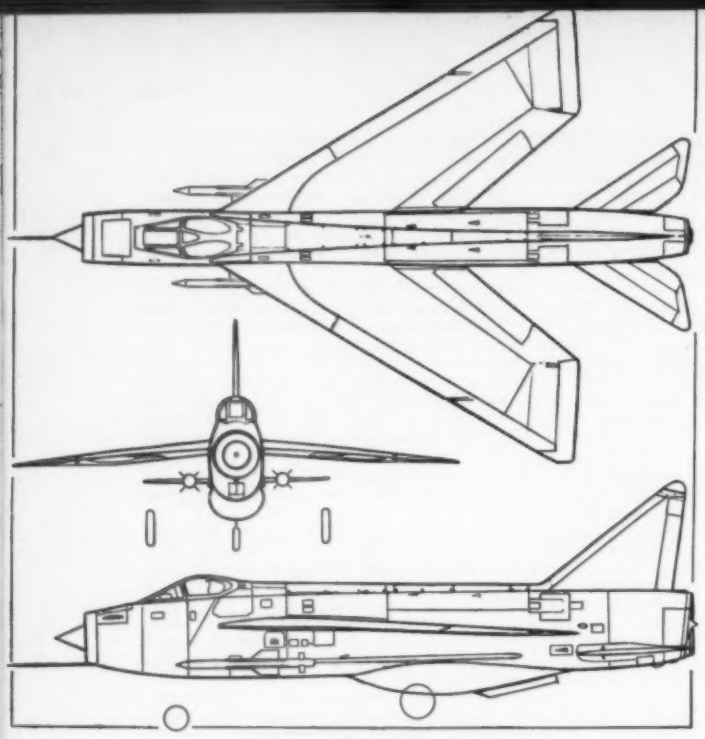
Powerplant Propulsion is provided by two Rolls-Royce Avon turbojets,[13] joined by varying lengths of jetpipe to reheat units and variable nozzles. The type of Avon may not be specified, but it is significant that an RA.24R has been publicly exhibited bearing the legend "upper engine." The RA.24R has air-cooled turbine blades, and ratings of 11,250lb dry and 14,430lb with reheat.

Engine air is taken in through the fixed-geometry, double-shock intake, the lip of which is fabricated in steel and protected against icing by bleed air. The air duct passes around the radar bullet, beneath the pressurized cockpit (the floor of which forms the roof of the duct back to station 14) and then opens out upwards and bifurcates at frame 23 to serve the two engines, ram air for the cabin-conditioning system being obtained along the bifurcation. At one point the floor of the upper duct is formed by the wing torque box. The sketch below clarifies the duct system.

Each engine is started by a Plessey LTSA.70 installation, burning Avpin (iso-propyl nitrate) contained in tanks in the fuselage spine. Each powerplant has a single cockpit lever governing thrust over the entire range of operating conditions. A fast-idling stop is provided, through which the levers may be moved to the idling and shut-down positions. As the levers are pushed forward, increased resistance is encountered at the reheat gate, beyond which point an electric control system selects any of four stages of reheat according to the position of the cockpit lever. Reheat fuel is



A schematic inboard profile of the Lightning F.1A clarifying the engine and duct geometry. The cross-sections are viewed from the rear, and the key-numbers are those employed in the large drawing on pp 46-47



ENGLISH ELECTRIC LIGHTNING F. Mk 1A

Two Rolls-Royce Avon turbojets with variable reheat. Span, 34ft 10in; length, overall, 55ft 3in; height, 19ft 7in; tailplane span, 14ft 6in; track, 12ft 9·3in; net wing area, 380·1 sq ft; sweep angles, leading edge 60°, trailing edge 52°; maximum speed, approximately 1,500 m.p.h. (M2.27); service ceiling, well over 60,000ft

LIGHTNING...

supplied by an air-turbine-driven pump for each powerplant, and separate igniters are employed to ensure immediate combustion of the reheat fuel at all altitudes. Area of the propelling nozzle is varied by 12 hinged segments coupled to a sliding ring positioned by a bleed-air motor.

Flying controls The basic system is completely conventional for an aircraft of this character, the ailerons, tailplanes and rudder all being irreversibly driven by Hobson hydraulic power units. All three sets of services are powered by two independent hydraulic systems, the ailerons having separate linear jacks, the rudder a tandem-piston unit and the horizontal tail being positioned by screwjacks driven through a gearbox by independent hydraulic motors. Linkages to the cockpit are simple push/pull tubes and levers; the hydraulic systems are discussed later.

An Elliott Bros (London) Ltd autopilot is fitted, providing largely automatic control in any of a variety of flight modes. The details of the system are classified; but in this journal's report of the 1960 SBAC show, we wrote:[14]

"More significant were certain components of two military autopilots being developed by Elliott for a supersonic fighter aircraft now entering service. A feature of the control panel of one of them was the use of mechanical interlocks between mode selectors to save panel space. A climb setting covers optimum climb performance under autopilot control and the inclusion of "track" and "glide" switches indicates automatic or near-automatic landing. Automatic throttle control is included. The main hand control is designed for use with the right hand outside the field of vision. Airpass has a controller for the left hand. It was stated that the autopilot hand controller could govern either extent or rate of turn, according to the mode in use. The barometric height lock is monitored, especially at low altitudes, by a radio altimeter to avoid excessive pitch demands."

Another logical assumption is that the Elliott autopilot is also linked to the radar fire-control, to fly the Lightning on the correct trajectory to effect the most economical interception. All signals from the system are passed as demands to the autostabilizer actuators inserted in each control circuit. All four autostabilizer actuators (there are two in the aileron circuit, one in each wing) are Hobson electrically signalled, rotary hydraulic motors, with a linear output connected to the appropriate control system in such a manner that it moves the surface but not the cockpit control.

Artificial feel is provided about all three axes. In the aileron circuit a simple torsion bar is inserted between the control column and the (normally fixed) aileron-trim drive, to provide feel directly proportional to stick deflection. In the rudder and tailplane systems, any control movement is resisted by a separate feel unit, in which deflection from neutral pushes a piston against hydraulic pressure governed by the feel simulator according to q (dynamic head) pressure, which varies with airspeed and altitude. These hydraulic feel units may be cancelled by a cockpit switch, and are automatically disengaged by a landing-gear DOWN selection. Further centring forces are provided by coil springs in each feel unit, which remain operative in the event of loss of hydraulic pressure or pitot/static differential, and a non-linear spring unit in the rudder circuit applies additional centring force and feel to the pedals.

Trimming is effected from cockpit switches, the rudder having a double switch on the port console and the other surfaces a four-way thumb switch on the control column. Each switch controls an electric actuator with a linear output which displaces the complete control run; the aileron trimmer is attached to the control-column torsion bar and the other units are linked to the autostabilizer/feel assemblies in the rear fuselage.

Fuel system It has long been known that the Lightning F.1A has an integral-tank wing, and that additional fuel is carried in the flaps and belly tank; but no indication may be given of the capacities of these tanks. The complete system is pressure-fuelled from a fuselage adaptor beneath the port wing trailing edge; and, for ferrying purposes, a Flight Refuelling probe may be attached beneath the port wing.

Fuel is transferred to the wing collector boxes and thence fed by SPE electric booster pumps to the engines. Reheat fuel is supplied by a separate Lucas bleed-air turbopump for each engine. Large recuperators in the main tank provide a limited supply of fuel for inverted or negative-g flight. The ventral tank is a stressed-skin box secured to the fuselage at a single point; it is not regarded as expendable, but can be jettisoned in emergency.

Hydraulics The Lightning hydraulic system is energized by four Integral gear/radial-piston pumps, one pair being mounted directly on the external wheelcase of each engine. Fluid specified is mineral-based OM-15, and ruling system pressure is 3,000lb/sq in. The system is divided into three completely independent subsystems: No 1 Controls System serves the outboard aileron power units, port tailplane motor, one half of the rudder power unit, braking-parachute doors and emergency gear extension; No 2 Controls System serves the other halves of the flying-control power units; and the Services System handles all other functions, namely, landing gear retraction, wheel and air brakes, flaps, nosewheel centring, autostabilization and feel, canopy operation and supplies to the various types of armament pack.

The forward pump on each Avon powers the services system, while the rear pumps independently serve the two controls systems. It is noteworthy that the two latter systems are separate in space as well as in drive, and there has never been a case of a Lightning losing all control power. No emergency ram-air turbine is fitted, for adequate control power remains even with both engines windmilling—and the odds are roughly a million to one against losing both engines. Each flying control is served by a nitrogen-charged accumulator for emergency use and to provide extra power for very high rates of operation. Hydraulic filters are by Palmer.

Electrics All electric power generated on board is obtained from a large Dowty-Rotol package, supported off the port side of frames 54 and 55, containing a radial-inflow turbine running on 15th-stage compressor bleed air. The unit can operate with either engine shut down, and is self-governing. On it are mounted a 20kVA alternator supplying three-phase, 400 c/s current at 200V, and a 28V d.c. generator. The latter can maintain essential services in the event of generator failure, and both service and emergency batteries are provided to serve critical loads in the absence of any power generation. A ram intake in the leading edge of the fin leads cooling air to the alternator, generator and gearbox oil cooler.

Air systems The two powerplants are bled of air at the 8th and 15th stages to serve a wide range of essential services. The biggest mass-flow is that required to drive the electrical turbine pack already described, but major components throughout the aircraft are served with air—some very hot and carried in lagged stainless-steel ducts with Avica-Flex gimbal joints, and some cooling air taken in from a variety of ram intakes. Apart from cabin conditioning, the major parts of the air system are those which drive the reheat fuel pumps, jetpipe nozzle rams and accessories pack; suitable airflows are provided for the various parts of the radio and radar systems, armament pack, fuel system, hydraulic reservoirs and other services. Special supplies are provided for intake de-icing, de-misting and rain dispersal.

Ducts from the main air systems lead to units which provide conditioned air to the cockpit, radar bullet and to the pilot's anti-g trousers and air-ventilated suit (and partial-pressure helmet). Broadly, the hot bleed air passes first through a Marston Excelsior air/air heat exchanger, then through a closed-circuit water boiler system (likewise a Marston unit, filled with distilled water plus anti-freeze, and having a steam vent to atmosphere in all positive-g conditions) and finally through a de Havilland cold-air unit. The cockpit supply is a mixture of this refrigerated flow and hot bleed air, passed through a water extractor. A heat exchanger in the final

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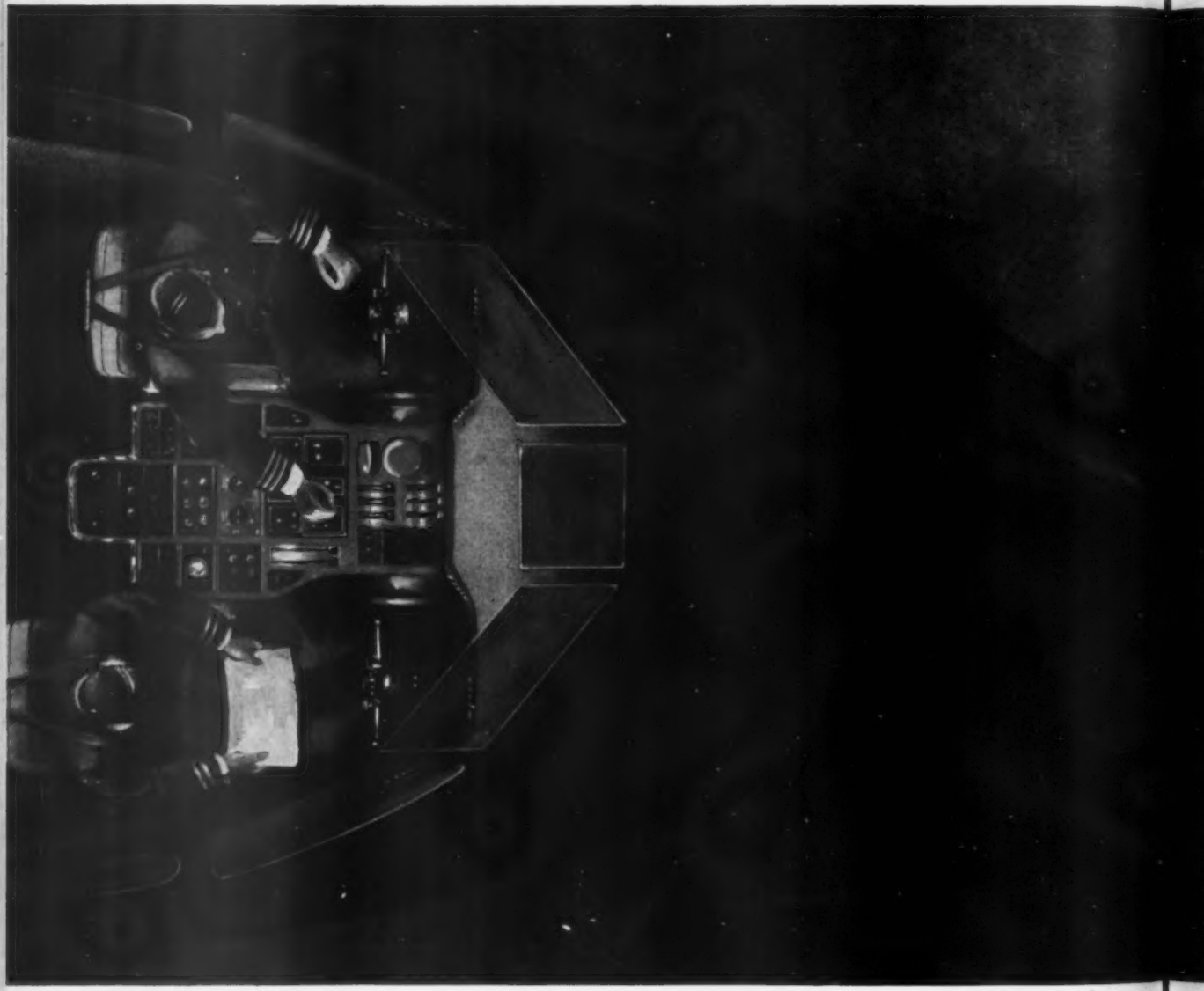
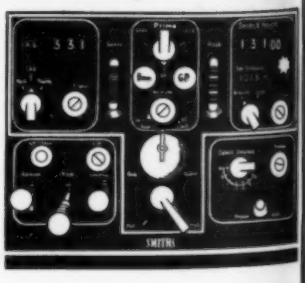
LIVES SAVED TO DATE BY MARTIN-BAKER EJECTION SEATS

M·B·A

SMITHS have a down to earth ap



In the automatic control and the fully automatic landing of aircraft, SMITHS lead the world. SMITHS Flight Control System is the only system in the world designed as a single entity to provide full automatic control through every phase of flight, including the landing manoeuvre. SMITHS Flight Control System, including Multiplex autopilot, is specified for the de Havilland Trident when it enters service for BEA. In matters of flight control and instrumentation the *automatic* choice is SMITHS.



th approach . . . automatically

Here is a brief factual report of SMITHS achievements in this field up to the beginning of this year:

SMITHS have been making automatic pilots since 1933.

SMITHS designed and made the first British electrically operated automatic pilot.

SMITHS designed and made the automatic pilot used in the world's first turbo-jet and turbo-prop airliners.

SMITHS automatic pilot (and associated equipment) is the heart of the world's first *fully automatic landing equipment* to go into production. This is the 'Autoland' system, in the design of which SMITHS collaborated closely with the Blind Landing Experimental Unit of the Royal Aircraft Establishment. The 'Autoland' system has been adopted by the Royal Air Force.

SMITHS automatic landing equipment has, in the last ten years, carried out more successful automatic landings than *all* other known systems in the world added together.

SMITHS embarked five years ago on a new generation of automatic pilots, designed to increase the safety factor to a level that will meet the stringent safety requirements that the civil air lines need for automatic landing.

SMITHS latest-generation automatic pilots will be the heart of the automatic system to be fitted in the de Havilland 'Trident' (under construction for BEA) and the Short 'Belfast' heavy freighter (on order for RAF. Transport Command). Negotiations are in progress with other operators.

SMITHS automatic landing equipment has been ordered by the USA. Federal Aviation Agency for evaluation tests in America.

The Flight Controller carries the switches and controls necessary for setting up automatic pilot and flight director modes and facilities. It is conveniently situated in a horizontal position behind the throttle pedestal. This unit has been designed for ease of operation and is unique in that the layout of the controls and indicators corresponds to the basic 'T' presentation used on the pilot's instrument panel.

SMITHS AVIATION DIVISION

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supply duct warms the refrigerated supply to the pilot's multi-services connection, to which a ground supply can also be fed to keep the pilot comfortable during "cockpit readiness."

Oxygen Surprisingly, the F.1A has a gaseous-oxygen system. The two oxygen cylinders are located in cradles in the nose of the aircraft, and are arranged to serve either a face mask or partial-pressure helmet.

Armament The first aeroplane in the Lightning family to bear arms was the P.1A WG763, which was fitted with a pair of Aden 30mm guns in the upper part of the forward fuselage. But the trend is away from guns, and guided weapons are regarded as the primary armament of all fighters equipped to carry them. In the Lightning F.1A the upper guns are retained, while the armament pack in the underside of the forward fuselage can be of any of three types. In all aircraft so far seen in service it accommodates equipment for two de Havilland Firestreak air-to-air missiles which are carried outboard on pylons projecting from the pack; but an alternative pack accommodates two further Aden guns and their ammunition, while the third arrangement is to fill the bay between frames 13 and 22 with two boxes each holding 24 spin-stabilized rockets.

Before describing this ordnance in more detail it is appropriate to turn to the system which enables the Lightning to find and follow its quarry: the Ferranti Airpass radar fire-control and the associated Pilot Attack Sight. This leads the narrator to regions which are sensitive to security, but the basic functioning of the system can be determined by previous reports. For example, at Farnborough last year we wrote:[15]

"Ferranti took some of the covers off Airpass I and Airpass II radar. Airpass II is a radar-fire-control and bomb aiming system, provided with additional facilities compared with Airpass I and developed as a private venture. Contour mapping, to assist in hill avoidance and to assist descents on to difficult airfields is included together with terrain clearance, or profile flying, facilities.

"A dead-reckoning navigational computer is available for the equipment, equipped with push-button inputs. When preset co-ordinates of points on the aircraft's route are fed in by pushing the appropriate button the computer will indicate the range and bearing to the point. It will operate from Doppler, air data or an inertial platform and is integrated into the radar display to present the range-bearing information as a deflection of the target spot or as a marker circle on the ground-mapping display. Inspection of the equipment shown indicates that many more transistors are used in Airpass II than in Airpass I.

"Particularly interesting is the new version of the pilot's hand control for the equipment. This is shaped for operation by the left hand only, conforming to its contours. Overall movement of the palm operates a rate control of the target spot, instead of the positional type of control used in Airpass I. In addition, the hand control also manages to incorporate two knobs and seven switches. Its sculptured ergonomic design could well be the forerunner of a whole new family of flying controls—particularly for high-g environments."

The upper gun installation comprises a pair of short-barrel Aden Mk 4 guns, with their blast tubes terminating in flush aperture plates on either side of the nose. The ammunition tanks sit directly over the guns, the empty links fall into chutes forming boxes down each side of the fuselage and the spent cases are ducted through pipes into the wing leading edges. The gun bays are purged by hot bleed air. If fitted, the lower gun installation comprises a self-contained pack, similar to that for the Hunter but mounting only two guns, and incorporating ammunition tanks and compartments for empty links and spent cases.

By far the most important weapons carried by the Lightning F.1A are the two de Havilland Firestreak air-to-air, IR-homing missiles. From this weapon de Havilland Aircraft have evolved a more advanced missile known as Red Top; but this is still some way from operational service, and has never been publicly associated with present marks of Lightning. Firestreak is, of course, a pursuit-course weapon, and this obviously governs its method of employment in the Lightning. As we have already surmised,[16] Red Top is probably—and certainly ought to be—a collision-course missile, capable of being fired at its target from any direction.

Apart from related cockpit equipment, all the airborne parts of the Firestreak weapon system are grouped neatly in the missile pack tailored to the armament bay. Most details remain classified, but the pack has been exhibited publicly and described.[17] It provides supplies of hot air to maintain the temperature of critical parts of the missile at high altitude; cold air, refrigerated by a closed-circuit ammonia system, to cool the IR seeker cell in the homing head (the need for this was first revealed at the 1959 SBAC show); and a range of electrical services, including special a.c. supplies from an alternator within the pack driven from the aircraft hydraulic services system. This equipment has been fully described.[18] All supplies are passed outboard through the pylons projecting on either side of the rear of the pack, and through the missile launch shoe. The starboard pylon incorporates a ram intake to cool the alternator.

Manufacturer of the alternative rocket installation is Microcell. Each pack is a metal-skinned, moulded reinforced glass-fibre box incorporating launching tubes for 24 spin-stabilized 2in folding-fin rockets. The two packs are attached by integral metal hinges, and are flipped open and shut by hydraulic rams governed by the fire-control system.

Details of the Lightning cockpit remain classified, beyond the fact that the seat is the Martin-Baker Mk 4BS, and that, as already reported, the ultimate OR.946 panel[19] has not yet been achieved. Directly in front of the pilot's eyes is the Pilot Attack Sight, immediately to the right of which is the AI radar display. To the left is an attention light which flashes when any of the red windows of the central warning panel illuminate (a loud fire-engine bell is also heard in the pilot's earphones). Upper and lower engines are controlled by matched power levers of curious form, immediately behind which are the weapon control panels and the miniature control column for the radar fire-control. The autopilot controller is to starboard, for the right hand.

Lightning F. Mks 2 and 3

Earlier this year it was officially stated that these two new marks of Lightning fighter were in an advanced state of development. No details may yet be given, but the following are some of the more obvious advances which either mark might incorporate: the engine might be the Rolls-Royce RB.146 Avon 300 series, rated at 13,230lb dry and 17,000 to 18,000lb with full reheat; in any case, the reheat system could be made fully variable; the aircraft could, with such extra thrust, incorporate a revised wing, of the type flown on the first P.1A; provision could be made for carrying any of a wide range of offensive stores, both under the fuselage or wings; the primary armament could be the Red Top missile; the OR.946 Integrated Flight System panel could be incorporated; a liquid-oxygen system appears an obvious choice; a steerable nosewheel could well be fitted; and either the internal or external fuel capacity might be increased.

Lightning T. Mk 4

Originally known as the P.11, and first flown on May 6, 1959, the T.4 is an operational trainer, with side-by-side seats for instructor and pupil. Full dual controls are fitted, and each Lightning squadron is being allotted one or two T.4s for dual checks and demonstrations. All operational equipment and armament is retained, flight performance is scarcely distinguishable from that of the F.1A and the T.4 can fly a fully operational mission if necessary. It should be emphasized that the function of the T.4 is primarily to assist pilots to become operationally proficient, although it is also serving as a pilot-conversion trainer.

This concludes the members of the Lightning family which may be mentioned at this time. Production machines have now flown well over 5,000hr, and "Bea" himself has flown Lightnings almost 800 times. More than 50 pilots have flown Lightnings, other than members of RAF Fighter Command, and their eulogistic comments jealously recorded by English Electric Aviation are a remarkable testimony from hard-bitten evaluation pilots. With this aeroplane one can fly and fight automatically at 1,500 m.p.h.; or one can take off in a filthy downpour on a pitch-black night along a 2,000yd standard strip; lose an engine at the most inopportune point; complete the circuit; make an approach in a strong cross-wind; touch with full fuel on board, overloaded, and lose the braking parachute (something which is virtually unheard of, as this journal recorded after visiting the first RAF squadron). And after all this, the pilot can climb down the ladder, say "No sweat at all," and mean it.

W. T. G.

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Ilyushin Il-18 of Aeroflot

RUSSIAN AIRCRAFT AND EARLS COURT

TYPES REPRESENTED IN SOVIET EXHIBITION

BY STANISLAV SHCHERBATOV

"FLIGHT" is happy to publish this exclusive contribution from a Soviet author. It does not add greatly to existing knowledge, nor does it purport to be a technical treatise. It does, however, contain items of real interest, and we print it—much as received—as a commentary on the aviation exhibits seen at the Soviet Trade and Industry Exhibition which opened at Earls Court, London, on July 7 and continues until July 29.

I AM happy to have the opportunity to write for *Flight*, which I have been reading for many years. Although the aircraft represented at Earls Court have in part been covered by past issues of *Flight* I hope that my contribution will add a few new facts. About a thousand square yards at the Soviet Exhibition in London are being given over to aviation, and the exhibits are mainly scale models, mock-ups and diagrams.

I shall begin with fixed-wing aircraft, and first the Tu-104. I hardly need to give technical details about this veteran jet airliner, since it has been regularly landing at London Airport for the last two years.

The Tu-104 is the workhorse of civil aviation in the USSR. Many have been used by Aeroflot on international services and on most domestic routes since 1956. The cabin layout has changed from 50 to 70 seats, while the Tu-104B, flying on short routes within the Soviet Union, can carry 100 passengers. Incidentally, Tu-104Bs make twelve return services every day between Moscow and Leningrad, a distance of 435 miles. In June 1959 a Tu-104 flown by Boris Kovalev carried a load of 15 tons over a 625-mile circuit at an average speed of 634 m.p.h., thus setting up six world records in a single flight. However, these are not the only world records held by the Tu-104.

"The basic version of the Tu-114 currently flying between Moscow and Khabarovsk—a distance of over 4,400 miles—has accommodation for 170 passengers"

The classical aerodynamic shape of the Tu-104 has served as a standard for a number of other designs, one of which has been embodied in the Tu-114 four-engined turboprop, the largest and heaviest commercial airliner yet flown. Its fuselage, although much longer, resembles that of the Tu-104. A major departure from established practice is that Tupolev has placed the engines in a backswept wing. Another novelty is that the engines have eight-blade contra-rotating propellers. This arrangement has considerably improved the power efficiency. The basic version of the Tu-114 currently flying between Moscow and Khabarovsk—a distance of over 4,400 miles—has accommodation for 170 passengers. With a cruising speed of 500 m.p.h. it covers the distance in nine hours. It can fly to practically any destination on the globe non-stop.

Of late, two other planes have been somewhat pressing out the Tu-104. These are Sergei Ilyushin's Il-18 and Oleg Antonov's An-10—both turboprop airliners. With their advent, Aeroflot has been able to divide its domestic and international services between four basic types of Soviet-built aircraft of different capabilities. Both the Il-18 and An-10 are powered by four turboprop engines. Although their cruising speed of 400 m.p.h. is somewhat lower than that of the Tu-104, the two planes have a greater range. The basic version of the Il-18 with accommodation for 85 passengers can fly up to 3,800 miles non-stop.

The An-10 has still better take-off and landing performance. Its range is of the order of 2,500 miles non-stop. A high-wing monoplane with a bellied fuselage on a low undercarriage, the An-10 is well suited for bulky loads, motor vehicles, etc. In summer it carries fruit and vegetables from inland areas, as it can operate from grass strips.

The Il-18 has entered service with the national airlines in the German Democratic Republic, Czechoslovakia, Ghana, Poland, China and some other countries. It may be hoped that the An-10 will also find a ready market.

The revolution brought about in Soviet civil aviation by the Tu-104 in 1956 is still going on. The point is that, with the change-over to turbojets and turboprops on major services, Aeroflot has had to look for better planes for local routes. One such, the Tu-124, has been designed by Tupolev, and another, the An-24, by Antonov. These two are to enter service with Aeroflot soon.

The Tu-124 resembles a scaled-down Tu-104. Its main novelty is turbofan engines, giving the plane a Mach number of 0.8 to 0.95. The Tu-124 has excellent take-off and landing characteristics and can operate from grass strips. Seating 44 passengers, it can fly over distances of up to 950 miles.

The An-24 is a turboprop airliner showing Antonov's typical "handwriting": a high wing and a bellied fuselage on much the same lines as that of the An-10. Two Inchenko engines give it a cruising speed of 350 m.p.h. Seating up to 40 passengers in some of its cabin layouts, it is designed for routes up to 1,100 miles long.

The An-24 shows Antonov's typical "handwriting"

The An-24 also features a number of structural novelties. One of them is the use of large-size panels in which stringers are made integral with the skin. As a result, the centre section is assembled of eight basic panels rather than from many hundred parts. The skin is fastened to the structural members by resistance spot-welding coupled with cements. Also, a novelty in aircraft construction, cement-welded joints have reduced the drag, increased mechanical strength, improved air-tightness and, of course, reduced the weight. All the trimming inside the cabin is of plastics. The cabin has fluorescent lighting fixtures.

Designer Antonov has pointed out that the An-24 had been designed specifically for domestic operation from small airfields, and the main aim had been to make air travel between small communities cheap and quick. The plane can take off from any land or grass strips which may be laid right on the outskirts of towns and villages, as the noise of the engines had been reduced to a minimum.

Rotary-wing aircraft have had a long history in the USSR. The first helicopter, powered by a 32 h.p. engine, was built by Boris Yuryev as early as 1912. Unfortunately, the First World War interrupted the work on this machine, which was similar to the single main-rotor helicopters of today.

Obverse of a Russian publicity leaflet giving particulars of the Kamov Ka-18 co-axial-rotor helicopter, known in the USSR as "the flying taxi"

At the present time the Soviet Union builds single main-rotor, contra-rotating, and tandem-rotor helicopters. The most common are single main-rotor helicopters, mainly designed by Mikhail Mil. Also popular are helicopters with two contra-rotating co-axial rotors designed by Nikolai Kamov. In all, four helicopters are being displayed at Earls Court: Mil's Mi-1, Mi-4 and Mi-6 and Kamov's Ka-18.

The Mi-1 was completed in 1948 and went into quantity production in 1950. Powered by a 570 h.p. Ivchenko engine, it has a service ceiling of three miles and develops a speed of 125 m.p.h. fully loaded. It has been continuously improved, and several versions exist now. One of them is an amphibious helicopter serving with fishing and whaling fleets. It also does a good deal of work in agriculture, on high-tension transmission line patrols, as a mail carrier, and on many other duties.

It will be no exaggeration to say that of all Mil's helicopters the Mi-4 is most versatile and most widely employed. It has a 1,700 h.p. engine and all-up weight of 18,800lb. With a payload of 3,500lb, the Mi-4 can develop a speed of up to 100 m.p.h. and climb as high as three miles. It has ample instrumentation for blind and high flying, a de-icing system, and hydraulic services. Hundreds of Mi-4s have been built in passenger-carrying, agricultural and helicrane versions. Incidentally, the helicrane version of the Mi-4 helps to erect TV and radio-relay towers, pylons, etc. Under the current Seven-Year Plan, the Soviet railways are to change over to electric traction, and this involves the erection of overhead wire supports. The conventional method of putting them up by means of cranes has proved uneconomical, as traffic has to be stopped where locomotive cranes are erecting supports. Vital help has come from the Mi-4. As a result, the helicopter is being widely employed whenever a high-tension transmission line has to be laid in mountains, or timber has to be shipped to hard-to-reach localities, or an emergency has to be met, not to mention its traditional duties as an ambulance, in geological and geophysical surveys, and as a transport in outlying regions.

Drawing on the experience gained in the design and operation of the Mi-1 and Mi-4, Mil has designed the Mi-6, the largest helicopter currently flying anywhere in the world. It is powered by two shaft-turbines and has a single main-rotor layout. The Mi-6 has an excellent performance, and has lifted 12 tons to 7,500ft. As to its commercial applications, the Mi-6 is indispensable when it comes to delivering tractors, bulldozers, lorries and other loads to the Taiga or to mountains. In a passenger-carrying version, the Mi-6 seats 80 passengers.

Only one of the Kamov helicopters is being shown at the exhibition. It is called the Ka-18, but is better known in the Soviet Union as "the flying taxi." In a passenger-carrying version it seats four passengers. Cruising at 90 m.p.h., the Ka-18 has a range of over 300 miles and a ceiling of up to two miles. The helicopter has two coaxial contra-rotating three-blade rotors and an excellent flying performance. The other versions manufactured are agricultural and ambulance.

A few words should be said about helicopter sport, which has gained so much ground in the Soviet Union that national contests have become a sort of tradition. They attract fliers from flying clubs, Aeroflot, the Air Force, the Central Glider and Helicopter School, and the Aviation Engineering Committee. A contest has five events. In one of them the contestants have to take off from a spot 30ft square, make a circle over the aerodrome at a height of 400ft, fly through a 45ft-wide corridor, and come in for a three-point landing by making a 90° turn. Marks are given on ten counts.

Some fliers have mastered stunts usual for fixed-wing aircraft, such as a dive, a zoom, a double-roll, a single roll over the rotor, and a climbing turn.

Immediate right, a cheery scene captioned in Russian: "Civil aviation helicopters are widely used for connections with remote districts of the Far East. Michina Kimonko, collective-farm bee-keeper, and his wife Nadezhda Kimonko met pilots Nikolai Maznikov and Nikolai Ermilov, who came flying to the village of Gvasiugi, Lazo District, Khabarovsk Territory, as one meets old friends." Far right, an Mi-1 helicopter competing in a contest entailing the lowering of cargo into a boat

Mooney's LAP "First"

IT is not often possible in these days to score a first since most everything now has been done before. But we in Dundas are very pleased to have had the distinction of being the first to make use of the new ruling on the use of London Airport [*Flight*, June 22]. This occurred more by coincidence than by planning; but, for the record, here are the facts.

We were informed by the Mooney Aircraft Co that in order to speed up delivery of our first Mooney Mk 21 demonstrator they had arranged on our behalf for Max Conrad Aviation to fly the aircraft across, arrival being planned for June 28/29. However, owing to a postal delay the C of A and C of R were not received in the United States until June 29. Then everything began to tick over like clockwork, thanks to Walter Moody the pilot. The aircraft departed from Boston in the late evening of June 30 for its nonstop flight to London Heathrow at a gross weight of 2,650lb, carrying in addition to its standard 48 US gallons a further 140 US gallons in two auxiliary tanks.

Though a transatlantic single-engine flight is nothing new these days, a nonstop one is still quite an achievement, this one being rather special inasmuch as it was the first Mk 21 to do so, the first one to us, and the first light aircraft into Heathrow under the new ruling. Walter Moody landed on 28R at 1433 local within 3 minutes of the ETA planned a fortnight before, having made the 3,300 miles from Boston very comfortably in 20½hr, leaving enough fuel to make onward continuation to Rome well within reach if desired. At a TAS of 161 m.p.h. she was burning 6 imp gal/hr and only used 4 qts of oil, which says a lot for the Lycoming 180 h.p. engine.

A fair amount of thunderstorms were encountered in the Gander area but successfully avoided; though snow, rain, and ice were prevalent throughout most of the flight, on arrival the Mk 21 looked as though it had just popped over from Gatwick, due to the high standard of finish; no rain or ice chaffing had taken place, and there was not even an oil stain on the cowlings.

Walter Moody, who had not had a drink since Boston as his thermos jug was found broken when required, was only a little stiff and still very fresh. This was his third trip across in June. He has 18,000 flying hours, which apart from the Air Force is almost all on ferry flying—singles, twins and fours. His longest solo single-engine flight is 63hr. Next week he will take a single-engine Lake amphibian from the United States to Nairobi.

We should certainly like to mention something of the men behind the scenes. From the Airport Commandant through air traffic, public relations and so on, co-operation, enthusiasm and all-round helpfulness were as much as anyone could ever wish for.

I have a sneaking feeling that the Ministry staff at Heathrow were as keen to see the new ruling implemented (and well implemented at that) as were the Business Aircraft Users Association and Royal Aero Club who were responsible for much of the effort behind making it possible. To all of these gentlemen we say "thank you very much."

In conclusion let us all hope that well-equipped aircraft such as the Mk 21 and others, together with capable pilots, will become a common sight at Heathrow, as I feel sure this will add flexibility to the arm of general aviation.

London SW1 KEITH E. JOHNSTONE
Mooney Sales Manager, R. K. Dundas Ltd

Hélène Dutrieu

IN this jet and space age few, if any, modern flying enthusiasts can have even heard of Mlle Hélène Dutrieu, yet once her name was front-page news for her exploits in the then new art of aviation. Her death in Paris recently must, however, revive nostalgic memories for those whose interest goes back to pioneer days.

Born in Belgium about 1880, dainty, vivacious little Hélène Dutrieu was already well-known at the turn of the century in the music halls of Europe for her daring feats in connection with "looping" on a bicycle and taking a plunging leap in an automobile.

It seemed only natural that when the aeroplane began to make its first short flights Mlle Dutrieu should become interested. She met the legendary Santos Dumont in Paris in the autumn of 1909 and he suggested that she learn to pilot his tiny "Demoiselle."

Hélène Dutrieu created quite a sensation when she appeared at Issy, the Paris flying-ground, in December 1909 in her very tight-waisted flying suit, helmet and goggles, and tiny patent leather boots; she created a greater sensation when she flew a complete lap of the course on the dangerous 60-mile-an-hour "Demoiselle," standing it on its nose on landing but escaping quite unhurt—being the first woman to fly a monoplane and the second in the world to fly alone. It was in August 1910 that Hélène Dutrieu passed the tests for her certificate on a Henri Farman biplane at Etampes, France, thus being the second woman to gain a pilot's licence, the first being Baroness de la Roche some months before.

Mlle Dutrieu in 1910

Radio Times Hulton Picture Library

Early in September 1910, Mlle Dutrieu flew from the sands of Blankenberge to Bruges and back carrying a passenger, M Beaud, and circling the famous belfry at a height of 1,000ft—the first cross-country flight by a woman.

In October 1910 she gave exhibition flights at the Burton and Doncaster meetings in England and was given much publicity for her flight over Burton with a passenger. On her return to France the same month a sensation was caused by the withdrawal of her licence by the Aero Club de France on the grounds that she carried a passenger (M Beaud) who in reality worked the controls.

Mlle Dutrieu at once flew the tests for her certificate, which was returned to her. After this she became very much "La Belle Hélène" to the early European flyers, and with the possible exception of the Baroness de la Roche was widely regarded as the leading woman flyer of her generation.

In December 1910 Mlle Dutrieu was the first woman to fly for an hour, and later the same month at Etampes she flew 167km in 2hr 35min on her Farman, winning the Coupe Femina. She retained this cup in 1911-12 with a flight of 3hr 54min.

In Paris just before the first war it was very fashionable to run out to Enghien to watch Hélène Dutrieu fly her waterplane over the lake. She would skim over the surface of the water, then rise suddenly to over a thousand feet and finally plane gently down on to the lake—a feat which never failed to enthrall the crowds. She also gave exhibitions with her Farman seaplane at Deauville and most of the French watering-places, doing much to popularize flying and no doubt making large sums of money for herself.

In 1913 Mlle Dutrieu was awarded the ribbon of the Legion of Honour for her services to aviation at a large reception given by the Aero Club de France. Early in the 1914-18 War she offered to fly as an unofficial scout to warn the French of approaching German raids on Paris, and in 1920 became the head of a motor business at Levallois Penet, apparently having no longer any dreams of aerial greatness.

In spite of her much publicized daring she was a most careful pilot and accomplished all those pioneer flights without any serious accident. The friend and pupil of Santos Dumont and Henri Farman, she outlived nearly all of the pilots of her era to pass away at over 80 in the era of Gagarin's first flight into space.

Cambridge NORMAN MORROW-TAIT

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

A "Compassionate" Licence

I HAVE received your letters of June 13 and 14. I note that you object most strongly to the attack I have made upon the standard and integrity of your journal but the issue of June 15 has done little to persuade me to change my mind.

In your letter of June 14 you say that the answer given by the Attorney-General will be noted in the issue of June 15. After considerable searching I found that it occupied slightly less than three lines on page 846, although the matter about which I originally

complained occupied some 42½ lines. If your latest effort is meant to be regarded as a proper method of putting the true facts before your readers I can only say it is not a view which I share. I repeat that I consider your treatment of this matter disgraceful.

I had hoped that it would not be necessary to draw your attention to yet further attacks by your journal upon Falcon Airways Ltd but I have noticed an article on page 841 in which you say, in relation to the proceedings of the Air Transport Licensing Board, that "the Board did not seem too pleased that Falcon had on their own admission been accepting deposits against bookings, and were now pleading disappointment to holidaymakers if their application was denied."

I refrain from making the obvious comment about the grammar of this sentence but I would invite you to check with the greatest care the information which gave rise to the sentence. It was perfectly clear from the evidence before the Board that Falcon Airways had never accepted deposits against bookings by holidaymakers and indeed had no right so to do. It is true that Flightways Ltd, the Travel Agents concerned, admitted accepting deposits from their customers but this has nothing whatsoever to do with Falcon Airways.

That sentence constitutes a quite inaccurate version of what took place before the Air Transport Licensing Board and I can only assume that either your information is not properly checked before publication or that you do not care whether or not you publish articles which do a great deal of unjustified harm to a Company which is striving to preserve a reputation which it justly values.

I can only suggest that the best way for you to put right both of the matters about which I have complained would be to publish this letter in its entirety and without alteration and indeed I both give you permission and an invitation so to do.

Bournemouth (Hurn) Airport, Hants F. E. BEEZLEY
Joint Managing Director, Falcon Airways Ltd

[Mr Beezley complains that the report in *Flight* for June 8, concerning questions asked about him in the House of Commons on June 5, did not record also the Attorney-General's answer that was given to those questions. As was evident from our wording, the issue concerned went to press before the answer was given.

This answer was duly recorded in the subsequent issue, in the following terms: "In the House of Commons last week the Attorney-General described as 'completely without foundation' an MP's allegations about Mr Frederick Beezley of Falcon Airways (*Flight* last week)."

We have, as invited by Mr Beezley, checked with the greatest care the information which gave rise to the report in our issue of June 15 about which he complains. We quote from the transcript of the actual hearing:—

"The Board: But nevertheless you did not shut down on the acceptances of bookings and deposits; you have, on your own evidence, gone on accepting bookings for another two months and those people, if they are disappointed with their holiday plans, can surely blame nobody but your company, because your company, as it seems to me—and correct me if I am wrong—has accepted their deposits in the knowledge that they could not be carried unless this Board granted a licence, largely on the ground that people from whom deposits had been accepted in good faith would be disappointed in their holiday. Is that right?

"Mr Beezley: That is perfectly correct."

(Mr Beezley went on to explain the economics of charter operations.)

Mr Beezley now says that the acceptance of deposits had "nothing whatsoever to do with Falcon Airways." This cannot be reconciled with his evidence, which we reported accurately, to the Air Transport Licensing Board.—Ed.]

[Invited to comment on the above footnote as this page closed for press, Mr Beezley remarked: ". . . the only comment I have to make is that, having carefully checked the transcript of the proceedings, I am fortified in my recollections and assisted by the recollections of other persons present that the answers attributed to me were not, in fact, made by me. The particular passages attributed to me in the transcript are the questions and answers between myself, the Board and Mr Sinclair of Flightways when he was being questioned by the Board. If you look at the transcript you will see from the heading of the page concerned that the witness was Mr Peter Sinclair and you will see that the paragraphs were headed Q and A respectively. It is true that my name appears in that part of the transcript, but merely because I was answering one particular question made by the chairman of the Board, and I know you will find if you check the matter carefully that the questions and answers were between Mr Sinclair and the Board and not between the Board and myself. I, however, accept that you may well have been misled by the form in which the transcript is typed."—Ed.]

Exotic Birds

DORNIER Delphin III, Dornier Komet, Heinkel He 64, Breguet XIX, Wibault 122-C2, Northrop 2E [picture herewith.—Ed.] Avions Fairey Féroce, Fokker F.VII, Dewoitine D.500. . . . Exotic designations that few people would associate with RAF roundels. Yet a specimen of each of these—and others equally unfamiliar in Britain—were, over the years, acquired by the Air Ministry for the study of some particular feature or features. Moreover Rolls-Royce acquired an He 70 for the flight-development of advanced liquid-cooled engines and Bristol employed a Northrop A-17 as a test-bed for the Hercules. In post-war years, however, Cranfield's Morane Paris is, I think, the sole addition to the list.

One wonders if further judicious acquisition of advanced foreign aircraft might not prove as rewarding today as in former years. How about an Il-18 off the shelf—if only to find out the engine overhaul life?

London WC2 A. PLANTER

P.166 on the Grass

IN the caption you published to the picture of Lord Derby's aircraft after its belly-landing at Luton (*Flight*, June 22) the brevity of the text is such that the true facts in the incident have not been clearly enunciated; moreover, the ambiguity in the description as to how the starboard wheel became defective could quite easily give a reader an impression disparaging to my name.

The actual cause necessitating the belly-landing was the failure of the outer race—that is to say the main tapered bearings—of the starboard wheel during the later stages of the take-off run at Liverpool, on a flight that was originally planned to Oxford.

The first indication that something was amiss came when the undercarriage indicator did not register a positive "lock-up" for the starboard wheel. Two further retractions were attempted to ensure that the indicator was reading correctly, and as the results were consistent I asked Lord Derby if he could see whether the starboard wheel was fully retracted. He replied: "it appears to be sticking out."

I considered that a return to Liverpool would serve no useful purpose and decided on a diversion to Luton where full technical facilities exist for this type of aircraft. On reaching Luton I lowered the undercarriage and flew around the aerodrome for several minutes. During this time a Rapide formated on me and from what its pilot could see of the starboard wheel as well as what could be seen by Capt Young and others in the tower, I decided that a belly-landing on the grass would be the safest course. My decision was made as a result of information received over the R/T, and I must stress that no advice was given me, although I was told by Capt Young that a belly-landing had already been successfully executed by a pilot in the USA.

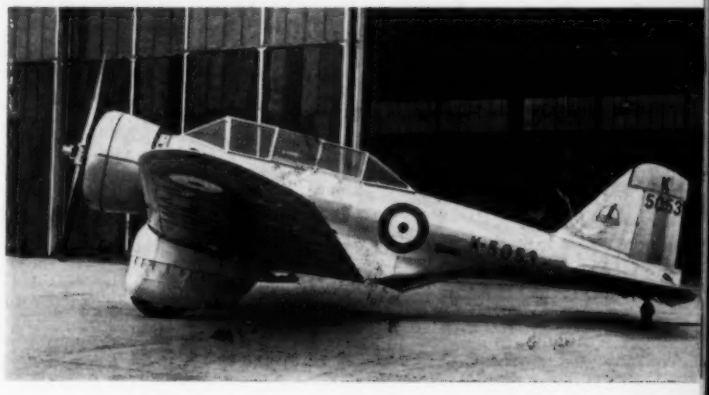
I have been flying continually since July 1936 and have a completely clean record. During this time I have, in non-combat conditions, experienced three emergency landings, all of which were for technical reasons.

I shall be most grateful if you will use this information—as you think fit—to correct any unfavourable impression that might have been given by your previous publication concerning this matter.

Oxford M. T. WAINWRIGHT

FORTHCOMING EVENTS

July	10-16	Aslib Aeronautical Group: Annual Conference.
July	12-19	University of Southampton/AGARD: Seminaron Astronautics.
July	13-15	RAeC: Lockheed International Aerobatic Competition and King's Cup Air Race, Baginton.
July	14-15	Marseilles-Provence Aero Club: Rally, Mejane.
July	14-16	Aerial Tour of the Pyrenees.
July	14-23	Angers Gliding Week.
July	15	RN Air Station Culdrose: At Home.
July	15	RN Air Station Brawdy: At Home.
July	15-16	Pescara Rally.
July	19	Kronfeld Club: Film, "History of the USAF."
July	22	RN Air Station Lossiemouth: At Home.
July	22-23	Basse-Normandie Aero Club: 13th International Rally, Flers.
July	25-26	Portuguese-Spanish Rally.
July	26	Kronfeld Club: "Gliding in Ghana," by G. A. Burgess.
July	27-29	International Business and Touring Aircraft Competition, Kidlington.
July	30-Aug 7	Derbyshire and Lancashire Gliding Club: Northern Gliding Contest.
Aug	1-13	Italian Gliding Championships.
Aug	27	Forli Rally.



The Northrop 2E mentioned in Mr Planter's letter

"Flight" photograph

Straight and Level

WHEN Mr Stephen Wheatcroft, the eminent air transport consultant, was called before the Air Transport Licensing Board as a witness for BEA (he is their economic adviser) I had a sort of moment-of-truth feeling.

The Board was listening to the evidence of someone who was not, so to speak, putting on a special act for the occasion. Here was the expert on the economics of international air transport who was simply saying what he has always said. If I can summarize it in one sentence, Mr Wheatcroft is not against airline competition—but it has to be regulated competition, and there has to be adequate route traffic density. In his view, the time is not ripe in Europe for competition between BEA and the independents.

His remarks about route density and its contribution to economic health were the theme of his book *The Economics of European Air Transport*, published five years ago. His remarks about allowing independent *v* State airline competition were the theme of his report for the Canadian Government, *Airline Competition in Canada*, published three years ago.

The Board was hearing someone who has perhaps thought and written more than anybody about the problems that our Board now has to resolve. Mr Wheatcroft has, during the last few years, been asked by half-a-dozen governments to report on their air transport problems. He is, I suppose, the man who could well have been asked by the British Government to write a report entitled "United Kingdom Airline Competition."

● From time to time during the Board hearings last week witnesses and advocates referred to an imaginary placard on the wall of the courtroom (put there by BUA's counsel, Mr Gerald Gardiner, QC), reminding everybody that the Board's duty is "*to further the development of British civil aviation.*"

This wording is from the opening sentence of the Civil Aviation Licensing Act 1960, and it defines the general duty of the Board.

In the dead of one night last week I crept into the Board courtroom and appended to this imaginary placard the words "*in the public interest.*" The following morning, to my dismay, I saw that the words had been removed. Some people have no imagination.

The Lord Mayor of London, Sir Bernard Waley-Cohen: "Is that the Mansion House, Captain?"
Capt D. S. Tibbits, HMS Hermes: "I will ask the navigator. Mr Twells, is that . . .?"
Lt M. Twells: "I think not, sir"

"Hey you down there. This is a Comanche of the Utah Highway Patrol and we're going to ticket you for speeding."
"So all right—I'm going to report you for low flying"

● For some years past there have been very few dissentient Press voices raised against airline pool agreements (all right, then, only one). Now *The Observer* (June 25) and *The Economist* (July 1) have joined in. *The Economist* describes pooling as a "cosy conspiracy." Most of the national dailies, in their reports of Air Transport Licensing Board hearings, seized on the lively exchanges on pooling.

It is the Board that has brought out pooling into the open.

Baconundrum XXXVIII

● Here are the two prizewinning answers to the above competition in this column, June 15, page 839. The winners are awarded jointly the bronze sculpture of a yawn, a photograph of which is reproduced herewith.

The first is from Mr Paul Dwerryhouse of 39 St John's Road, Eastham, Wirral, Cheshire:

If one applicant and one objector take 18¾hr of the Air Transport Licensing Board's time, then 69 applicants and 257 objectors will take $\frac{69 \times 18\frac{3}{4}}{257}$. With 30 routes this $= \frac{69 \times 18\frac{3}{4}}{257 \times 30} = \frac{345}{2,056}$

Therefore it will take 345hr to hear the applications and 2,056 hr to hear the objections, a total of 2,401hr.

Assuming the Board devotes 10hr per week to the case, it will therefore go on for nearly five years.

The second winning answer is in Latin, from "Duae Discipulae" of 31 Wallis Way, Streatham, London SW16:

Responsum problemae tuae "Baconundrum XXXVIII" est XVI et dimidius horae XXXXVIIIIMCXIV dies.

Secundus pars est nemo atque secundarii adversarii non basilicam plenus principalis adversarorum referere poterunt.

Est Latinus tuus atque validus atque arithmetica noster?

Bronze sculpture of a yawn

● Air-India's general manager, Mr B. R. Patel, says that the American attitude to Air-India's request for more air services to the USA is "fantastic and unreasonable and largely a reflection of the attitude of the US carriers."

Do we take it from this that it is wrong for the Indian Government to reflect, in its negotiations with other governments, the interests of Air-India?

● Man, Cunard Eagle and Pan American are right with it—real groovy ads on that way out Radio Lux, like crazy. Those BOAC and BEA cubes better get with it likewise, dig?

ROGER BACON

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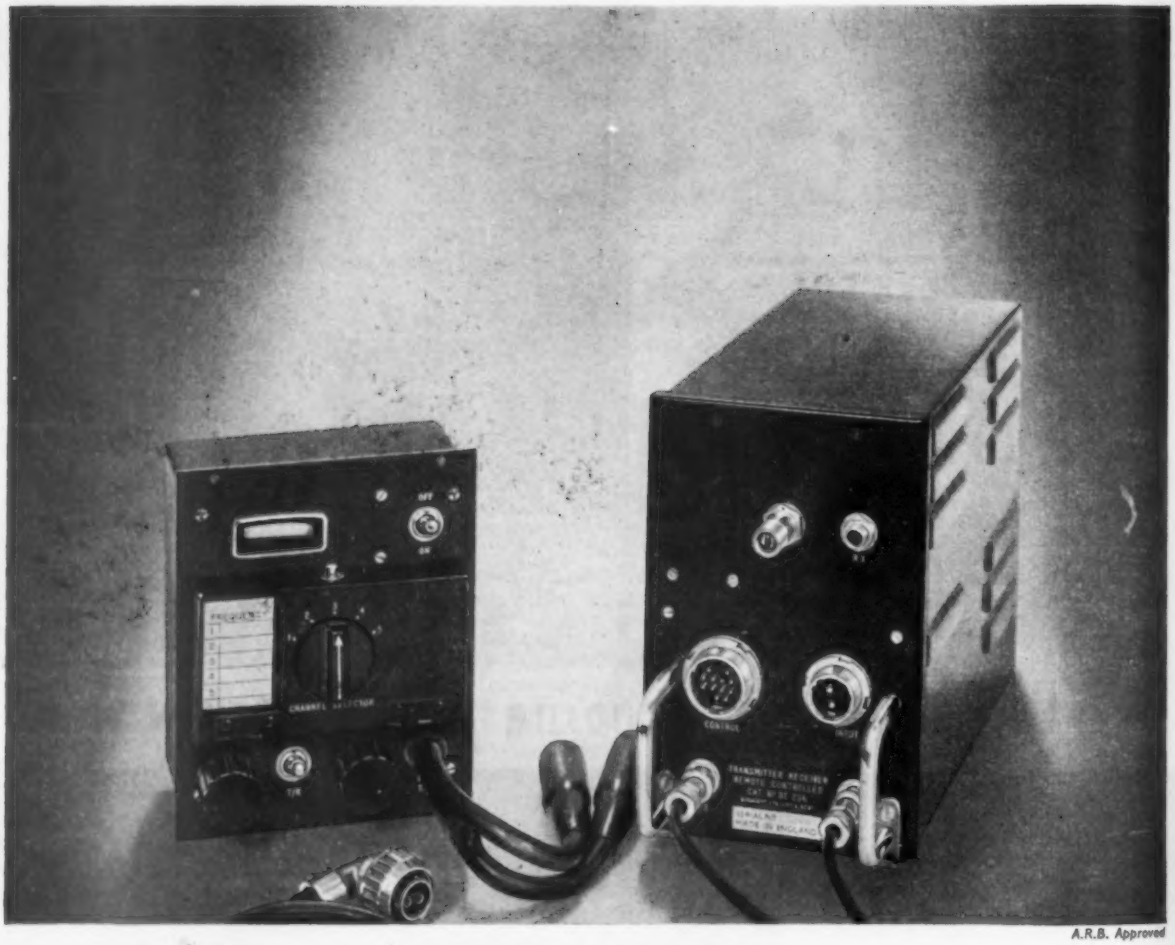

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AIR COMMERCE

AQUAPLANING: A NEW BOGY-WORD

THE Falcon Airways Hermes G-ALDC which over-ran the runway at Southend on October 9 last year was the first British public transport aircraft officially said to have suffered from the phenomenon of "aquaplaning," hitherto known in puzzled safety circles as hydroplaning.

Under exceptional conditions, when moving fast on a wet runway, the wheels of an aircraft can become fully supported by the hydraulic pressure of even a thin film of water. In these circumstances the wheels can be braked and even stopped without causing any appreciable deceleration; this phenomenon has been suspected for some time but has only recently been experimentally demonstrated. In spite of considerable research the precise conditions under which aquaplaning occurs are not yet fully understood.

The Ministry of Aviation accident report presenting these conclusions quotes eyewitness reports that the rain was moderate to heavy at the time the Hermes landed. The Hermes touched down about 600ft beyond the threshold markings at a speed estimated by Capt Wilkinson, in command, as 105 to 110kt. The nosewheel was lowered on to the runway about 4 to 5sec later and brakes then applied, but after about 6 or 7sec Capt Wilkinson realised they were having little effect. To preclude the possibility of his having inadvertently locked the wheels by applying too high a pressure he released the brakes and reapplied them, using light pressure at first then increasing to the maximum. Although the pressure gauge indications were normal there was no noticeable braking effect, and as by this time the Hermes was about half way along the runway Capt Wilkinson thought it was then too late to take off again. As the aircraft approached the end of the runway he tried to turn it to the right using nosewheel steering, but the speed was too high and although the heading was changed the direction of travel was only slightly altered and the Hermes skidded off the runway.

Tests after the accident revealed that the brakes were serviceable and capable of achieving the designed braking force. Apart from some scalding (blistering of the rubber) and scoring of the treads the main wheel tyres were in good condition, and attention was directed to the question of runway friction. Tests were made with a small braking force trailer, and these seem to bear out recent aircraft tests that have shown that in a relatively small amount of water the coefficient of friction between tyres and runway, which determines brake effectiveness, can fall to between 0.075 and 0.22 at 100kt from a peak of about 0.8. These tests have shown that the friction coefficient falls with increase of forward speed, i.e., from 0.5 at 10kt to 0.1 at 100kt, with a tendency to remain constant thereafter. It is thought likely that the decrease from 0.5 to 0.1 could be due to the tyres becoming increasingly supported on a film of water. At the higher speeds less water is removed from the tyre contact area due to the shorter time that the pressure exerted by the tyre is maintained at any single point on the water film. A condition can then be reached when the tyre is no longer in contact with the runway and can be said to be aquaplaning. Scalding of the Hermes' tyres could only have occurred with the wheels locked with a film of moisture between tyres and runway. As a result of this incident the minimum landing distance for the Hermes is being increased, and landings of the type at Southend will only be possible at light weights.

LOFTLEIDIR DOES WELL

THE annual report of Loftleidir, placed alongside those of almost any of its Big Brothers in IATA, would probably pale into insignificance. Yet it is a remarkable document, not only because it shows how this non-IATA carrier has actually improved its position with an all-piston fleet in a year in which jet deliveries for North Atlantic operation were building up to a peak. Just as remarkable is the degree of information provided, which is all the more praiseworthy for a small, privately owned, unsubsidized carrier which does not have to account to the taxpayer for its affairs, and which might be excused a degree of commercial secrecy of the kind maintained by Britain's independents.

For instance no European airlines give such detailed information, or any information, on the prices paid for second-hand equipment bought or sold. Loftleidir's two ex-PanAm DC-6Bs were supplemented by a third bought from PanAm for $630,000 and delivered on March 4 this year; a down payment of $198,000 was made and the balance paid with promissory notes guaranteed by the Icelandic Government. Loftleidir's last DC-4 was delivered to an English buyer on March 11 this year; its sale price was $145,000 in cash, and its sale marks the end of nearly 14 years of DC-4 ownership by Loftleidir. A second aircraft of this type was leased to Interocean Airways SA of Luxembourg and later sold to that carrier on August 3, 1960, for $180,000, a favourable price considering the market for DC-4s. In addition, one DC-4 was leased from Braathens SAFE during the whole of 1960 and a second DC-4 for part of the year.

Loftleidir points with justifiable pride to the fact that it carried more passengers last year than five of the 16 scheduled airlines operating the North Atlantic route. And, in spite of heavy taxes, perhaps 1.4m kr, the board of directors recommended an 8 per cent dividend for the stockholders—a good old-fashioned commercial practice which ought, but won't, trouble the consciences of some of Loftleidir's competitors.

JETS AND ARAB POLITICS

WHAT effects are current events in Kuwait likely to have on further sales of Comets to Middle East operators, and on the Arab League idea of a pan-Arab airline? As related in our February 24 issue, both Iraqi Airways and Kuwait Airways are potential Comet customers, as are Saudi Arabian Airlines, but the latter is reported to have signed a letter of intent for three Boeing 727s with an option on three more. A Boeing sales team is in the Middle East and is reported to have held discussions with United Arab Airlines, who are interested in the 720B and 707-320B; with Trans Arabia Airways, of Kuwait, who are considering the purchase of two 720Bs; and with Saudi Arabian Airlines, Iraqi Airways and Iranair.

Kuwait Airways is owned by Government and local interests in Kuwait, and has been managed by BOAC since 1958, a profit being guaranteed by BOAC Associated Companies. There has been talk of MEA, also a BOAC associate, taking over the management of Kuwait Airways, ordering a fifth Comet 4C to be operated on the latter's behalf for services from Kuwait to London, which have been planned for some months now.

To meet Cunard Eagle and Pan American competition on the routes between Florida and Nassau, BOAC has transferred to its wholly-owned associate Bahamas Airways three Kuwait Airways Viscount 802s. Here is the first, converted by Scottish Aviation, a 52-seater with an attractively re-styled interior designed to appeal to the US holidaymaker. Bahamas Airways' Hermes, lavishly re-styled for the same service 18 months ago when the airline was mainly privately owned, will be superseded by the Viscounts

AIR COMMERCE...

A BUSY YEAR FOR THE BOARD

Lord Brabazon Reports on the ARB's Year

WHEREAS the big event of the ARB's 1959-60 year was the Board's certification of the Boeing 707-420, its twenty-fourth annual report, for the year ended March 31, is more concerned with aircraft at the other end of the size and weight scale, particularly imported American types. The issue of C of As for series aircraft numbered only 95 in the year under review, compared with 139 the previous year and 227 the year before. But validations of foreign certificates of airworthiness have trebled almost exactly, the 1960-61 total being 152 whereas the 1959-60 figure was 53 and the 1958-59 total 23. This reflects not only the large imports of American and Continental light aircraft but the smaller number of secondhand airliners acquired to re-equip the independents' fleets.

Introducing the report, Lord Brabazon, the ARB chairman, referred to the early "mixed feelings" about rationalization of the aircraft industry into two or three large groups. "We now know that many of the fears were groundless. The threat of widespread redundancy has not materialized and the Society of British Aircraft Constructors continues to report increasing production, in particular for the export market."

Lord Brabazon, chairman of the Air Registration Board

The Board's responsibilities, as a result, have been broadened, not least by the technical examination of pilots and engineers adding turbine-engined airliners to their licences. Some post-war types of aircraft with single- or two-spar wing construction using high strength "zinc rich" aluminium alloys are still operating, and as in previous years, great effort has been needed on the part of constructors, operators and the Board to avoid fatigue failures. In more recent years the "zinc rich" alloys have been largely discarded in favour of a lower strength "copper rich" alloy which has remained crack-free or in which crack propagation is much slower. This, in conjunction with a change in design policy to the fail-safe principle, gives the Board greater confidence for the future.

Good progress has already been made with the airworthiness and safety standards of supersonic and STOL aircraft, while more and more of the Board's time is being devoted to the problems of automatic flare-out and landing. "From the Board's point of view," says the report, "reliability is the important issue and, remembering the degree of complexity of the equipment which integrates the electrical, electronic and radio systems, approval and certification is no easy matter." Type approval of airborne radio and the examination and licensing of radio maintenance engineers may be delegated to the Board, which has already had the task of examining the various British hovercraft prototypes for ultimate certification as a transport vehicle. "Not unnaturally," says the report, "the executive find it attractive to consider safety requirements for a craft which operates at an altitude of about 12 inches and, because of this, regulations and requirements are not likely to be onerous." The need for operators to obtain before April 1, 1961, an Air Operator's Certificate from the Director of Aviation Safety, MoA, means added responsibility for the ARB, who will have to assess an operator's competence in maintenance and, following the granting of a certificate, supervise personnel and facilities.

US-UK Reciprocal Acceptance

There is still a residue of differences between US and UK civil airworthiness requirements regarding transport aircraft, and although it seems virtually impossible—with the need to keep requirements up to date—to achieve absolute uniformity, the additional requirements which must be met by the US or UK constructor seeking certification of an aircraft in both countries are clearly established; and in the case of some recent aircraft there were less than a dozen points which had to be discussed with officers of the FAA. The main difficulties are now experienced with the small American types; in the States these are certificated in compliance with certain performance requirements in standard atmospheric conditions, whereas British requirements—for public transport operation in accordance with the Air Navigation Regulations—demand information on performance in the temperature/altitude conditions in which the aircraft is to be operated. The difficulty of obtaining such data for American light aircraft has proved troublesome to the Board and to British buyers of such types.

Equipment certification has also raised some problems. There are two classes of equipment, that which is "type-certificated"—i.e., engines, propellers, flight instruments—and that which is not. There is a fundamental difference regarding the latter: in the USA the aircraft manufacturer is responsible for the airworthiness of purchased equipment and may therefore require absolutely complete information on its design and manufacture. British equipment firms find it irksome, and even prejudicial to commercial security, to supply such detailed information, and it is normal practice for the British equipment manufacturer to be approved by the Board. The aircraft constructor can base his acceptance and testing of equipment on "Declaration of Design and Performance" by the equipment maker, but if he wants to use American equipment he is unable to get such a declaration backed by FAA approval. No satisfactory solution to this problem has yet been found.

Among the Board's contributions to the ICAO Airworthiness Committee meeting at Montreal last October was a new draft specification for the measurement of landing distance, based on methods developed in the UK and included in the current BCARs. Working groups of the ARB's Supersonic Aeroplane Airworthiness Committee have met several times and studied performance and handling, structures, atmospheric conditions, fuel systems, air-conditioning, engine installation and flight development. Full certificates of airworthiness were issued to the Vanguard, Herald and Argosy during the year under review, while the Avro 748 and Skyvan are expected to be certificated in the next year. There will then be a "waiting period" while the Westland 192C, Short Belfast, Trident, DH125 Jet Dragon and VC10 complete their flight tests.

The Ministry has accepted the Board's proposals for the introduction of a UK Certificate of Airworthiness for Export, which can now be issued for new or used aircraft exported from this country. Apart from certain administrative advantages, this procedure aligns the Board's practice with those of other airworthiness authorities. Validation test flying of foreign aircraft has involved the flying of a wide variety of types, including the Fokker Friendship, Dornier Do 28 and Do 27.

—AND WORDS FROM THE LUNCHEON

SPEAKING at the ARB's annual luncheon at Claridges on July 6 Lord Brabazon said that for 15 years the Board had put up with him as chairman, which showed what a good lot they were. The older people got, he said, the more active they became—"and some, I can assure you, are a damned nuisance." Having been in existence now for 25 years the Board still had three of its original members —Maj R. H. Thornton, Mr Guy Johnson and Mr E. R. H. Hill. The Board could not do without its treasurer, Mr J. J. Taylor, whom he congratulated on his recent additional appointment to the Air Transport Licensing Board. Lord Brabazon went on: "Our staff, in dog parlance, may be small but they are well marked. They can hold their own with any experts in the world. We bask, for example, in the reflected glory of Tye [Mr W. Tye, chief technical officer], and Hardingham is—well, Hardingham. This is a peculiarly English organization and to run it you have to have a Hardingham." They were all, he thought, probably worried about what he was going to say: "Perhaps they think I am going to relate JP.4 to birth control, but they need not be worried."

Mr R. E. Hardingham, secretary and chief executive

The manufacturing industry was now, he said, about to introduce "a new horror"—the supersonic transport. It had been said in America that at 20,000ft it would break your windows and at 50,000ft it would make a noise like a clap of thunder with the lightning a hundred yards away. Most enjoyable. He thought that we were about "to commit another ghastly mistake." To upset lives of decent people at all hours was something that they would not

Seen at Buckingham Palace after receiving his knighthood is Sir Basil Smallpeice, managing director of British Overseas Airways Corporation. With him is Lady Smallpeice

tolerate; "they will rise in their wrath and will demand the suppression of this remarkable machine that you are thinking of building, and I think they will be within their rights. I am an old man, but I will myself lead a procession to wreck the Ministry of Aviation, provided it is the sort of procession in which people are allowed to sit down frequently."

The Parliamentary Secretary to the Ministry of Aviation, Mr Geoffrey Rippon, replied on behalf of Mr Peter Thorneycroft, the Minister, who was absent abroad. Mr Rippon noted that Lord Brabazon had never felt particularly inhibited in what he did or said and he thought it was a splendid thing that we had an independent body like the ARB with a chairman who had a certain latitude in what he said. Mr Rippon thanked the Board for the advice it had given the Minister on the standards required by airline operators for the award of air operators' certificates. He thought that the Cairns Committee report on accident investigation methods had made a great contribution to the subject, and his Ministry was discussing it with the parties concerned. He hoped it would not be too long before the Minister could make known the steps he proposed to take. Talking about the past, he thought it was possible to say with hindsight that it was "a terrible tragedy" that we did not go ahead with the V.1000.

Maj R. H. Thornton made a speech of customary wit and elegance, welcoming the guests; there were warm hear-hears for his congratulations to Sir Basil Smallpeice, managing director of BOAC, on his knighthood.

Replying for the guests was Mr M. J. Lighthill, Director of the Royal Aircraft Establishment, who, in describing the RAE's present work, mentioned the "truly inspiring prospect of European co-operation." He also remarked that the RAE was opening up special new research into the short-haul air transport travel market and hoped to form a high-level working party to examine the subject.

DIPLOMATIC DELAYS

SOME prominence was given by the newspapers last week to an incident at Gatwick Airport on July 1 when 82 holidaymakers were delayed some 24hr. They were due to fly to Palma by Falcon Airways in an aircraft chartered by Sky Tours. When they were told that the flight could not leave because of unserviceability, the passengers spent the night at a West End hotel. When they arrived at Gatwick again the following morning they were again told by the travel agent that there would be a further delay: it was hoped to leave at 10 p.m. A Falcon Airways official was quoted as saying: "Our own aircraft was unserviceable. We chartered one from the French company UAT on Saturday, but the Spanish authorities refused permission for it to operate to Palma."

Asked (1) what was the unserviceability that, as reported by the *Daily Mail*, had delayed the flight, and (2) whether diplomatic clearance for the flight had been obtained from the Spanish authorities prior to initial embarkation of the passengers, a Falcon Airways spokesman replied to these questions—and to others relating to Falcon Airways air operator's certificate (asked before the development reported below)—that he did not think it would be proper to answer at that stage.

A spokesman for Sky Tours said that there was no doubt whatsoever that the necessary diplomatic clearances had been obtained for the original flight; but the proposal to sub-charter the charter flight to UAT necessitated reclearance, and this was not forthcoming before the unserviceability was rectified.

FALCON APPEAL TO THE MINISTER

THOUGH Falcon Airways was not among the list of operators (*Flight*, April 27, page 576) who had at that time been awarded an air operator's certificate by the Minister of Aviation, such a certificate was subsequently granted. However, it contained restrictions limiting operations to region C, which includes the European and Black Sea areas, whereas Falcon wanted a certificate covering a wider area.

Falcon have now lodged a formal appeal with the Minister against this restriction, and in accordance with the regulations the Minister has referred the appeal to a commissioner; Mr J. Roland Adams, QC, has been appointed by the Lord Chancellor. Mr Adams will be assisted by a technical assessor, Capt J. C. Harrington.

The hearing was due to open yesterday, July 12, at 10 Carlton House Terrace at 10.30 a.m. The regulations provide that the hearing shall be held in public unless the appeal commissioner decides otherwise.

AMERICA v. THE WHITED SEPULCHRES

IN a note under the heading "The Poker Game" over a year ago (June 3, 1960, pages 770-771) we said that relations between Britain and the United States, following the breakdown of talks on the Bermuda Agreement, were rather cool. If anything, relations are now cooler than ever. Admittedly, the two sides have at last reached a "provisional" agreement on the Caribbean—though this is an area that was supposed to have been sorted out in March 1960, the only agreement that was reached at protracted talks in Washington and later in Barbados. The US is now given the right to operate New York - Jamaica (a route on which PanAm jumped the gun in December 1959, and which it has since been allowed to operate anyway) and Atlanta - Jamaica. The route between Antigua and New York is granted to the UK until BWIA can take it over with Federal independence, due on May 31, 1962.

The United Kingdom, whose team from the Ministry has been led by Alison Munro, has been acting as trustee for the West Indies Government pending Federal independence, but UK interest in the Caribbean has not been entirely altruistic, because BOAC do not want to lose, when they lose BWIA with West Indies independence, the traffic rights that they enjoy in the booming US tourist playground of the Caribbean—and in particular Jamaica. The future of BWIA was the subject of a report by a commission of inquiry last year headed by Sir Frederick Tymms, the report of which has incidentally never been made public.

The coolness really arises not so much out of the West Indies problem, as of the CAB's demand for fifth and sixth freedom traffic statistics, with a view possibly to amending foreign carrier permits to reduce capacities. When this move was first announced (*Flight*, February 17, page 223), the British Government's reaction was vigorous and immediate. So was that of all the other countries, mainly European. Protests were to the effect that Bermuda-type agreements between the US and foreign countries provide for "fair and equal opportunity," and that any attempt to control capacities is a breach of this agreement. In a letter to the State Department the British Government said: "*If foreign air carrier permits were amended in this manner, the Civil Aeronautics Board could unilaterally determine in advance such questions as the capacity, frequency and type of aircraft which would be provided by United Kingdom airlines on flights to and through United States territory. The conditions under which United Kingdom airlines may operate to and through the United States are those set out in the Bermuda Agreement, which, as both parties have invariably agreed, does not give either party the right to determine unilaterally such questions.*"

There the matter rests. The Americans, who in 1946 were the only international air transport country of any consequence, now regard every foreign aircraft as a bird of prey. There is no doubt that Pan American and TWA are really concerned about the diversion caused by the carriage of fifth and sixth freedom traffic, most of it originating in the US, by foreign airlines. The American outlook is no longer, as it was at Bermuda 16 years (and half a dozen aircraft generations) ago, liberal-minded.

The words that American spokesmen then uttered about liberality are now being dug out from the archives and fired back at the US by the sportsmanlike, fair-playing British—who in 1946 were the ones that wanted restriction and control of capacity. Perhaps relations are not so cool that the Americans cannot fire at us the passage from St Matthew about Pharisees, hypocrites and whited sepulchres. They can hardly say we are full of extortion and excess; but unless relations become warmer the US will be difficult about the foreign carrier permit that Cunard Eagle now seeks. J. M. R.

The first of 15 ex-TCA DC-4Ms acquired by Overseas Aviation is now, the company states, operating in the temporary livery of the Gatwick-based independent. This is one of their ex-BOAC aircraft

ATLB PUBLIC MEETING 21

HERE we continue our report of the Air Transport Licensing Board's biggest and most complicated hearing to date. Key figures are the chairman, Prof Jack, whose deft handling of the proceedings is in the Terrington tradition; Mr Henry Marking of BEA and Mr Ashton Hill of Cunard Eagle, whose expertise in argument and cross-examination matches that of professional counsel (which their companies have not employed); and British United's counsel, Mr Gerald Gardiner, QC, whose highly skilled advocacy is of the agreeably friendly and non-forensic kind appropriate to an air transport hearing.

CROSS-EXAMINATION of Mr Whybrow, a BUA witness, on the comparison between N. Atlantic and European fare structures and trends was continued by Mr Marking for BEA. He suggested that the charts and tables produced by BUA were misleading in that they were based on propeller services across the Atlantic, which would be only 6 per cent of the total in 1962-63, and that the European routes considered had been chosen because they favoured BUA's case—excluding, for example, the Gibraltar and Malta routes, which had the lowest rates per mile outside the British Isles. First-class fares had not been taken into account; these were 85 per cent higher than tourist fares over the Atlantic but only 37 per cent higher in Europe.

Mr Whybrow said that the lowest fares available to the public had been considered on both routes; N. Atlantic fare changes being considered by IATA might affect jet services. The 18 routes BUA had used as a basis for European figures were a representative cross section: special low fares were available on two-thirds of them.

Mr Marking referred to the charts prepared by BEA, introduced at the end of the previous hearing, which included night excursion fares in Europe, and were based on a different selection of routes. He suggested that BEA 52 showed a generally lower fare level in Europe than on the N. Atlantic, taking April 1958 as the base point and taking into account European night inclusive tour rates. BEA 53 showed that there had been a drop of over 3d per passenger-mile on European routes and over 2d on domestic routes since 1947.

Mr Marking suggested that the BUA traffic statistics might be misleading as they might not include figures for certain coach-air and short distance cross-Channel services which carried heavy traffic. He also suggested that transit passengers might have been included in the numbers of passengers to certain European countries. Mr Whybrow stated that the source of the figures used by BUA was the Board of Trade, Mr Marking suggesting that the figures might also have been influenced by the inclusion of free and rebated passengers, and asking whether Mr Whybrow would assess these as 10 per cent of the total. Mr Whybrow said it would, in his opinion, be more like 5 per cent.

BEA's Inclusive Tour Traffic

Mr Marking next questioned Mr Whybrow about inclusive tour traffic and asked whether he knew how many IT passengers had been carried by BEA; Mr Whybrow said he did not, as the figures were not included in the BEA report. Mr Marking then produced a chart (BEA 55) showing IT traffic on BEA and independent aircraft and asked Mr Whybrow to agree that this showed that BEA had in fact carried more IT traffic up to 1956 and had again overtaken the independents in 1958-59. Witness wanted to know the source of BEA figures and Mr Marking remarked that he was asking the questions.

Counsel for BUA asked Mr Whybrow about IT traffic, and the witness quoted from the BEA report for 1959-60 which stated that BEA's IT traffic had increased by 46 per cent in the summer of 1959. The ATAC report for 1960 had also commented on the reduction in IT business by special flights as a result of the availability of IT bookings on scheduled services. This intervention, together with that of foreign carriers on pooled services, was seriously affecting the IT business of the independents. Counsel also asked whether the Gibraltar and Malta routes were cabotage routes and therefore not subject to IATA control of fares; Mr Whybrow confirmed that this was so. Asked what he thought would be the future pattern of fares on the North Atlantic and European routes, Mr Whybrow said that he thought European fares would probably go down in about 1965, and Atlantic fares would be sharply reduced.

Mr F. A. Laker, executive director of the Air Transport Division of BUA, was the next witness. Questioned by counsel, he said that BUA's proposed Victoria Station Air Terminal would not depend on the success of the applications. Heads of agreement with the British Transport Commission had been signed. BUA would go ahead with this project, which would have the advantage of providing air facilities at the traditional gateway to the Continent, with good rail connections to Gatwick, which was the main terminal and operating centre of BUA, who had spent about half a million pounds on hangars and workshops and were now spending a further £85,000 on an administration block. Gatwick was readily available to people living in South and South-East England.

Mr Laker felt there was scope for parallel operation. Traffic was increasing. A second carrier using an airport complementary to Heathrow would benefit passengers and produce useful competition. He was not in favour of pooling agreements.

BUA had originally decided to re-equip with Trident aircraft but various considerations, including the possibility of rapid turnrounds and greater flexibility of operation with smaller aircraft, the ready availability of the manufacturer's base at Weybridge, good take-off performance and rapid climb—with consequent reduction in the nuisance caused by noise—had led them to change to the BAC-111. The company's finances were adequate for this re-equipment. Questioned by counsel about finances, Mr Laker said that a major company such as BUA needed a share of scheduled services to provide a reasonable degree of security in view of the high cost of equipment. Trooping contracts were marginal—a major contract had operated last year at a price which represented only 1.4d per passenger-mile—and were normally initially for one year, but could be broken at three or six months' notice.

Effects of Pools

Inclusive tour business had, he said, been pioneered by Airwork with Polytechnic Tours in 1948, and had gone ahead rapidly after regularization in 1952. ITX fares [inclusive tour fares on scheduled services] had been introduced in 1959 (effective in 1960) and independents had carried less IT traffic in 1960 than in 1959. Mr Laker thought that special IT flights would be virtually finished within ten years.

Counsel for BUA continued his examination of Mr Laker with a reference to three agreements which had been put in by BEA, and asked what proportion of traffic from the UK was generated by the UK. Mr Laker estimated seven to every one generated elsewhere: of the total traffic BEA carried about 56 per cent. Questioned on the effects of pools, Mr Laker said that he thought that these discouraged staff by removing the incentive of competition, diverted revenue from British operators and led to operation of restricted frequencies at high load factors. He thought that a load factor above about 70-75 per cent meant that the ceiling of traffic for the frequency operated was being reached. If a term were to be imposed on any licence granted he would want this to be at least the write-off term of the aircraft to be used. BUA could start operations on any route for which a licence might be granted by 1963. They expected delivery of BAC-111s to start in 1964 and would want a licence extending until 1973. Building up a service would take time and he would not expect to achieve the hoped-for load factor at first.

Mr Marking, for BEA, began his cross-examination of Mr Laker by reference to a pamphlet issued by BUA at approximately the date of application by BUA for the licences being considered (*Flight*, January 27, page 128). BUA had stated in this pamphlet that the routes for which they were applying represented the minimum required for economic operation. Mr Marking referred to the withdrawal of certain of these applications and asked whether this meant that the remaining routes, for which BUA were still applying, could not be economically operated.

Mr Laker explained that work had been found since the time of the applications to occupy five of the ten Viscounts that had then appeared likely to be surplus to requirements. In reply to further questions, he explained that this work included services to Las Palmas, Tenerife, Sierra Leone and the duplication of the Sudan Airways service to Khartoum and had not all been contemplated at the time the applications were submitted.

Questioned about his resentment of BEA's competition on inclusive tour traffic, he said that he considered this unfair competition. Contracted tour work was short-term and seasonal, whereas BEA were able to offer inclusive tour rates on any route and at any frequency. He thought the unrestricted activity of BEA was unfair competition in view of the restrictions imposed on the independents. Mr Marking asked whether he thought that BEA's 56 per cent of European air traffic and large proportion of inclusive tour business were the result of competition from a monopoly which BUA had suggested was "complacent and supine"; he also asked how Mr Laker reconciled his statement, in a TV interview, that BUA's existing network only had enough scheduled service work to cater for one big jet and that they needed "a minimum of nine aircraft with an increased scheduled network to make it a viable situation commercially" with the suggestion that the indepen-

dents could operate routes at lower cost than the corporations. Mr Laker replied that they could do so, with the same routes and similar aircraft.

Mr Marking asked Mr Laker to confirm a press conference statement, at the time BUA announced their order for jet aircraft, that ten were unconditionally ordered and an option on a further five would be taken up if the licences were granted (*Flight*, May 18); Mr Laker replied that the continued use of Viscounts meant that BAC One-Elevens would be enough for BUA's existing commitments. Further questioned, Mr Laker said that if the licences were not granted, BUA would use some of the BAC One-Elevens ordered and get rid of the others.

Mr Laker was questioned about BAC's estimates of operating cost for BAC One-Elevens, which Mr Marking, using a BAC advertisement in *Flight* for June 15 to support his argument, suggested might be optimistic, since manufacturers' claims were seldom pessimistic. Mr Laker said that he thought BUA's estimates were conservative; although the company had never pioneered the operation of a new type, they had considerable experience and had operated the Britannia 317 at less than the manufacturer's figures.

Unfavourable to Britain

Finally, Mr Marking referred to the agreement between the UK and Portugal, which provided that total capacity should be shared equally between the carriers of the two countries. Mr Laker said that this agreement was unfavourable to Britain as it meant that the Portuguese would have 50 per cent of the traffic on a route where they produced only 16 per cent of it. This would mean British passengers travelling on and helping to finance a foreign airline. Mr Marking then commented that the agreement had been made as the only means of securing routes to Portugal, and Mr Laker agreed that the passengers were being carried in British aircraft in any case.

The Board asked Mr Laker to clarify the position regarding BUA's order for BAC One-Eleven aircraft. Mr Laker said that only ten aircraft were on order, five for existing services and five intended for use on scheduled services.

This concluded BUA's general case, and Mr Marking next cross-examined Mr Ashton Hill, of Cunard Eagle Airways.

Mr Marking asked whether Cunard Eagle held any route licences other than those for routes which they were currenty operating. Mr Ashton Hill suggested that the question was not relevant. Mr Marking said that the Board should have some assurance that Cunard Eagle, if granted licences, would operate services. He asked Mr Ashton Hill about a number of routes for which Cunard Eagle were licensed. Mr Ashton Hill said that one, from Manchester to Oslo, was being operated to Bergen; Manchester - Innsbruck was being operated via London but not direct; Manchester - Brussels would be operated; about Manchester - Rotterdam he was not sure; Cunard Eagle were not operating the other six. Asked why the licences for these routes were not being used, Mr Ashton Hill said that they had withdrawn from the Manchester - Göthenburg route because they did not want to operate to Helsinki. BEA had taken over the route and had not operated it.

Questioned about Cunard Eagle's choice of routes now applied for, Mr Ashton Hill said that they had not applied for any of the uneconomic domestic routes because they had to satisfy the Board that there would be no material diversion of traffic. To suggestions that Cunard Eagle were trying to take the cream of the profitable routes, Mr Ashton Hill replied that they were seeking a percentage of the future growth of traffic. The Board asked what percentage and Mr Ashton Hill said about 7 per cent. Asked by Mr Marking to comment on the suggestion that the Cunard Eagle revenue 1962-63 would represent 55 per cent of BEA's planned growth from 1961-62 to 1962-63, he said that this depended on the frequency to be operated. Cunard Eagle would not operate to the maximum frequency until 1965-66.

Mr Ashton Hill was cross-examined by Mr Oswald, for the British Transport Commission, who asked him to confirm his statement that Cunard Eagle had chosen routes on which there would be no material diversion from BEA, which Mr Ashton Hill did. Mr Oswald asked whether diversion from the services of the British Transport Commission had been considered; Mr Ashton Hill said it had not and, to the suggestion that BTC had the right to appeal to the Board, replied that the Board would be guided by the Act which instructed them to "exercise their functions in such a manner as to further the development of British civil aviation."

Mr Porter, of Tradair, was the next to be cross-examined and, replying to questions from BEA's advocate, stated that Tradair had not yet ordered aircraft for the proposed services but were confident that they would be able to acquire them when necessary. They had not wanted to advance as an argument orders placed in anticipation of a successful outcome to their applications. Control of the block bookings would be effected on a system similar to that used by BEA. Agents would accept blocks of seats, to be released back to Tradair on set dates. The services would not be advertised as schedules to the public, only to the tourist trade.

Mr Marking then began BEA's general objection to the applications. He said that BEA had not sought any accommodation with the applicants; it was for the Board to decide, in such a way as to "further the development of British civil aviation," and added that the Board was not there, as had been suggested, "to give the independents a fair crack of the whip." Seven applicants were making applications for 58 European and 11 domestic routes, but were so little in agreement that they had made over 200 objections to one another's applications in "this greedy struggle for plum routes."

The cumulative effect of the applications must be considered, said Mr Marking, and he quoted from Mr Duncan Sandys' speech on the second reading of the Air Transport Licensing Bill, in which he had said that the corporations, as the country's main flag carriers, deserved, and would get, the Government's full support and encouragement. That was what Parliament had had in mind when passing the Act. BEA's evidence would stress the great importance of economic factors, which were being clouded by emotional play on the virtues of competition. BEA did not deny that, in general, competition led to better service at lower prices, but this theory was not applicable to international civil aviation. If economic damage to BEA resulted from the Board's decision, the taxpayer and the national interest would suffer.

The deal between Cunard Eagle and British United Airways showed that what they wanted was not competition but a protected share of someone else's business. The applications represented attempts by shipowners to extend their operations to the air; they must not be allowed to damage the British flag carrier.

International law meant that permission must be sought to fly into foreign countries, hence bilateral agreements with general provision for "fair and equal opportunity" which had generally been taken to imply equal frequency and capacity. The proportion of the total capacity which BEA could offer was therefore restricted, and was now being used to the full. A second British operation on any route would destroy the balance.

The chairman of the Board here intervened to ask to what extent BEA's case was relying on pool agreements, in view of the dispute over the admission of these agreements as confidential documents. Had the Board directed that the pooling agreements be produced BEA could have pleaded their confidential nature, but the corporation had put them in voluntarily. Prof Jack suggested that a statement of the general principles of the agreements might be acceptable and asked the views of counsel for BUA.

Mr Gardiner pointed out that Mr Marking had referred to the pooling agreements in a way which conflicted with the Portuguese bilateral agreement, which provided for more than one foreign airline operating to Portugal. Mr Marking promised that pools would be referred to in general terms only. He went on to say that a second operator could not increase the British quota, as would be shown by the evidence of Sir George Cribbett. In fact, he said, the British share might be diminished by a reduction in the solidity of the British effort.

BEA's Domestic Services

Mr Marking then spoke of domestic services. These caused no international complications, but competition must be on terms of equal obligation. Because of their mixed status as commercial and welfare undertakings, nationalised undertakings had special responsibilities. BEA's included the operation of some routes which were unprofitable, but the independents had not applied for such routes. The Board must keep in mind the possible effect on the inhabitants of the Highlands and the Islands of Scotland, remoter districts and the Isle of Man if the licensing of other carriers on good routes made it necessary for BEA to withdraw these unprofitable services. The alternative would be to support them by subsidy, the cost of which would be borne by the taxpayer.

Case law had yet to be built up and, with reference to the decision on the recent Cunard Eagle Atlantic applications, Mr Marking agreed that diversion alone was not a mandatory reason for refusing a licence, but there must be some compensating gain. In Europe there was none.

Mr Marking invited the Board to note the experience of the USA, Canada, Australia and New Zealand with unrestricted competition on air services. With reference to Section 2(2) (g), BEA had £140m capital commitments in jeopardy. The Board must be satisfied that there would be a balance of advantage if the applications were granted.

Summing up, Mr Marking said: (1) A second operator would not increase the British share of the traffic; (2) The gain to the applicants would be at the expense of BEA, causing severe economic damage and loss in power to compete on European routes; (3) Domestic routes could not support a second operator and the licensing of one might imperil the continuance of unremunerative routes. Therefore the applications were not in the best interest of British civil aviation.

[*To be continued*]

At the Guild of Air Pilots and Air Navigators recipients of Meteorological Office awards in London on July 4 were, left, Capt A. L. French of BEA and, right, Capt E. H. Jones of BOAC. Presenting the awards (brief cases) was Dr A. C. Best, centre, director of services of the Meteorological Office. The awards are given for outstanding service in providing weather reports

AIR COMMERCE...

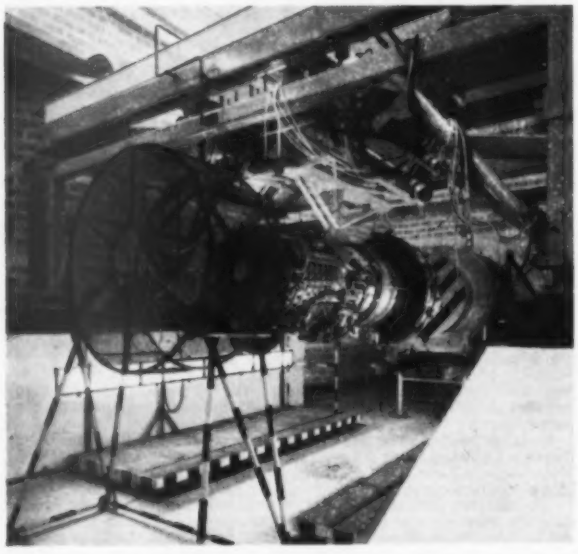
TRIDENTS FOR KLM?

A STRONG possibility that an order for ten de Havilland Tridents will be placed by KLM was the subject of reports last week. The airline emphasizes that no final decision has been made—the choice lies between the Trident and the Boeing 727, with Caravelle 10 a strong contender. The Trident, it appears, is running as the favourite. Delivery of series 1s could be made early in 1964.

KLM, which has one of the most diversified fleets of any of the big international operators, appears to be planning for an all-jet fleet of three basic types. The Convair 990 is the obvious candidate for the airline's medium-range requirements, particularly in the Far East and South America; the negotiations between KLM and the SAS/Swissair consortium are continuing, with a view to technical co-operation in the operation of DC-8s and Convair 990s. Some of KLM's DC-8s (seven series 30s and five series 50s) would be freed by Convair 990s to concentrate on long-haul routes, particularly the North Atlantic and Polar services.

There remains the problem of a jet replacement for the short/medium haul Electra, of which KLM has a fleet of 12 (including the one leased to Air Ceylon). It is for this job that the Trident now appears to be favoured. KLM's well-known interest in autoflare and Smiths PVD (the last-named equipment being fitted in one of KLM's DC-8s) would logically strengthen interest in the Trident, which has been planned from the outset particularly for autoflare and autoland.

KLM's present fleet is as follows: six DC-3 freighters, used in Europe; three DC-3s, leased to De Kroonduif in Dutch New Guinea; ten Convair 340s, eight in Europe and two in the Caribbean; nine Viscount 803s; two DC-6Bs (on charter work), six DC-6s (in the Caribbean); two DC-7Fs; thirteen DC-7Cs (more of which may be converted to 7F standard); two Lockheed Super Constellation 1049Hs; seven L1049Es (four of which are withdrawn from service); ten L1049Gs (three withdrawn from service); twelve Electras (one with Air Ceylon); and twelve DC-8s (seven series 30 and five turbofan series 50.)



Swissair's new test cell is now ready to receive the Pratt and Whitney JT4s of its DC-8s and the General Electric CJ-805s of its Convair 880Ms and Coronados

ROTODYNES FOR PUERTO RICO?

A LETTER of intent for five Rotodynes has been signed with the Kaman Aircraft Corporation by the new company Indies Air (Indair) of Puerto Rico, for operation on routes throughout Puerto Rico, the Virgin Islands and the Caribbean area. Kaman is the US manufacturing and sales licensee for the Rotodyne.

Indair propose to start services with "suitable fixed-wing aircraft" as soon as route applications are approved. Westland have worked with Kaman and Indair on an extensive study of Indair's route proposals.

BIATA OPENS THE DOOR

AT what stage does a new airline attain, for want of a better word, the respectability that is so important commercially? Certainly, in the case of new British independents, respectability is earned by the words that go around the travel industry, the Ministry's safety people, the petrol companies, etc. Of course, companies can and do become respectable before they are admitted to membership of the British Independent Air Transport Association—but membership of BIATA is the accolade. Three new members, just announced, are Air Safaris, Overseas Aviation, and Tradair. This brings the total BIATA membership to 14, as follows: Air Safaris, BKS, British Aviation Services (Silver City), British United, Cambrian, Cunard Eagle, Dan-Air, Derby, East Anglian, Jersey Airlines, Overseas Aviation, Skyways, Starways, Tradair.

Flashback to Mr Dromgoole of Overseas reported in *Flight*, June 24, 1960: "I wouldn't say we haven't tried to join BIATA. We have asked to do so on two occasions. . . . An organization like BIATA, purporting as it does to represent the whole independent industry, should be inclusive and not exclusive. There are now eleven independent companies outside BIATA. I have not suggested that BIATA have refused membership to Overseas Aviation, but that we have been made to feel that we would not be welcome."

BREVITIES

Sabena has just ordered two more Caravelle 6s for delivery in July and August, bringing the total number of Caravelles in its fleet to eight.

The apron at Khormaksar, Aden's civil airport, is to be extended and improvements to the terminal buildings are planned to meet the requirements of increasing air traffic.

Following the discovery of a cracked elevator hinge bracket in an El Al Britannia, all of BOAC's 31 Britannias were X-rayed and six were found, up to July 6, to be in need of modification.

British United Airways has been awarded a contract for the movement by air of Servicemen and their families to and from Germany, beginning on October 2, and using Viscounts. This contract marks a complete changeover to air transport for this task.

Indian domestic fares are to go up in October by 10 per cent for travel in Viscounts and 5 per cent for Dakotas because of the mounting wages bill of Indian Airlines Corporation. It has not yet been decided to increase fares for Friendship services.

A comprehensive study has been started within BOAC of the future of air cargo as it affects the corporation; "task forces" of BOAC executives will be aided by Mr Heinz J. Heinrich of Heinrich Aviation Consultants of Montreal.

A complete economic survey of the possibility of air freighting New Zealand's primary produce to overseas markets has been completed. It will be considered in detail by a departmental committee which will report back to the New Zealand Cabinet.

PanAm has reduced the loading time of its DC-7F Cargo Clippers to an hour from three and a half hours by means of its new AirPak palletized cargo loading system. Seven pallets, each carrying up to 6,700lb, can be accommodated in each DC-7F.

Membership of IATA has increased to 92 airlines with the admission of three new carriers: Air Guinee, Air Mali and Trans Atlantica Argentina. There are now 13 Latin American and 13 African airlines in IATA.

TWA's 27 Boeing 707s and 20 Convair 880s are being fitted with new Collins DME units at a cost of about $500,000. These DME sets replace earlier units first used on TWA's 707s early in 1959, and will be fitted to the 30 Boeing jets currently on order for TWA.

Finnair and SAS have concluded a new pool agreement covering routes between Finland and Scandinavia, and valid for a period of five years. The agreement also covers extended technical co-operation between the two airlines. A previous pool agreement was in force until April 1960.

TCA's operating loss last year is blamed directly on competition from CPAL on the Montreal - Vancouver route. Mr W. G. Wood, TCA's vice-president sales, told a Canadian House of Commons committee that this service had cost TCA $5.8m (about £2,071,000) in lost passenger revenues.

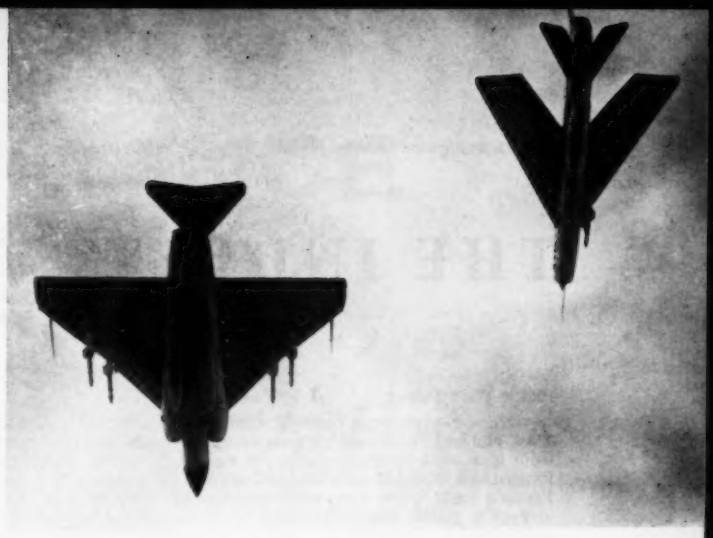
The crash of a Finnair DC-3 on January 3 was attributed to the pilot and co-pilot being in no condition to fly, due to the effects of alcohol and lack of sleep. The commission investigating the accident confirmed a police statement that the two pilots had spent much of the night before at a party.

The second prototype Avro 748, G-ARAY, is now undergoing a period of five weeks tropical trials at Nicosia, and will return to England via Madrid, where a further week's programme of high-altitude, high-temperature test will be carried out. Skyways will receive a 748 this autumn for route proving trials.

According to *Aviation Week* Frontier Airlines have signed a letter of intent for six BAC One-Elevens (two Rolls-Royce Speys). The value of the contract would be about $12m and the order depends on negotiations this autumn and the signing of the contract before January. Ozark Air Lines have already signed a letter of intent for five BAC One-Elevens and Continental Air Lines are also now studying the aircraft with a view to a possible order.

New RN Squadron

A NEW RN air squadron, No 771 Helicopter Training and Trials Sqn, was being commissioned at Portland last Tuesday. Equipped with four different types of helicopter—Wessex, Whirlwind, Dragonfly and P.531—it is the first air squadron in the Royal Navy to be specifically commissioned and equipped for a training and trials task. The commanding officer is Lt Cdr A. I. R. Shaw, MBE, AFRAES, RN.



A Javelin of No 41 Sqn (Wg Cdr D. W. H. Smith) with a Lightning of No 56 (Sqn Ldr J. R. Rogers), one of the latest squadrons to be armed with this type, which is described in an article on pp 44-51. Both machines are carrying Firestreak air-to-air missiles

SERVICE AVIATION

Air Force, Naval and Army Flying News

Aden Prospect

WHEN Exercise "Prospect" was held in London during May 1958, as a conference explaining the policy of the Royal Air Force to a representative cross-section of public opinion, presentation of the overseas commands took the form of an interview between the exercise director, Air Cdre F. E. Rosier, and a defence correspondent. During it the air commodore said of the RAF command at Aden: "Its main job is to look after our interests in the Aden Protectorate, the Persian Gulf and also in Kenya and British Somaliland. In fact it looks both ways, northwards to the Persian Gulf and, as it were, backwards into Africa."

Now, as AVM Rosier, he is to get first-hand experience of Aden—a "hot seat" in view of the recent Kuwait crisis—as AOC Air Forces Middle East, a post he takes up on August 2, succeeding AVM D. J. P. Lee. Since July 1959 he has been chairman of the Joint Planning Staff, Ministry of Defence, and concurrently Director of Plans to the Chief of the Defence Staff; previously (when in charge of Exercise "Prospect") he was Director of Plans at Air Ministry.

AVM Rosier, who is a CB and CBE and holds the DSO, was a fighter pilot in the Second World War. When flying with No 229 Sqn over Belgium in the earliest days of the war he shot down two Messerschmitts but had to bale out when his petrol tank was set on fire. Alight himself, he beat out the flames as he parachuted to earth. After spending a short time in an Arras hospital he set off for Britain, on the way being injured again when his train was heavily bombed. He subsequently commanded No 262 Wing in the Western Desert, later (1944 and 1947 respectively) becoming OC Northolt and Horsham St Faith. Between these appointments he flew on operations from Continental bases.

Royal ADCs

TWO appointments as Aide-de-Camp to the Queen were announced in the *London Gazette* last week. The new ADCs are Gp Capt J. B. Tait, DSO, DFC; and Gp Capt A. G. Douglas, MC.

Tomorrow (July 14) at Episkopi in Cyprus the NEAF branch of the CFS Association holds its annual reunion dinner: here SACW Shirley Whitehorne appropriately puts finishing touches to a scale model Avro 504, so closely linked with the early days of the Central Flying School

Kuwait Support

SOME idea of the comprehensiveness and variety of RAF support in the Kuwait landings may be gauged from the numbers and types of squadrons involved. For transport duties, there were Nos 216 (Comets); 99 and 511 (Britannias); 30, 47, 53 and 84 (Beverleys); 24, 36 and 114 (Hastings); and 233 (Valettas). For short-range transport, Nos 78 (Twin Pioneers) and 115 (Twin Pioneers and Pembrokes). For ground attack, Nos 8 and 208 (Hunters); for bomber support, Nos 88 and 213 (Canberras); for PR, No 13 (Canberras); and for MR and ASR duties, No 37 (Shackletons).

Arming a Hunter of No 8 Sqn, from Aden, with rockets at Kuwait: Cpl Peter Williams (left), Sgt Ken Humphreys and SAC Jack Weatherup. See "Kuwait Support" (above)

Wessex in Service

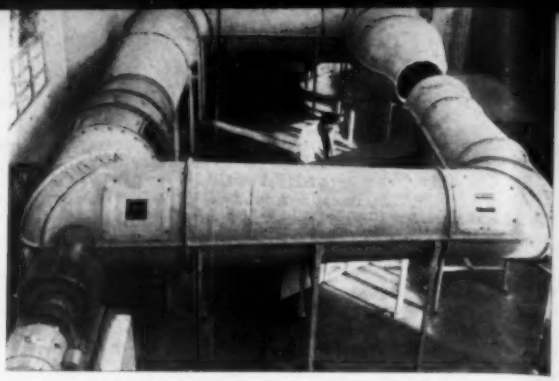
ON Tuesday of last week No 815 Sqn of the Royal Navy was formerly commissioned at RNAS Culdrose. The squadron, commanded by Lt Cdr Tony Skinner, is the first to be equipped with the Westland Wessex and is destined for HMS *Ark Royal*. In his address the captain of Culdrose, Capt C. Webb, DSC, RN, said that 815 had the potential to be "the best squadron in the best AS force in the best Navy in the world." At the end of the ceremony a silver model of the Wessex was presented to the squadron by Capt H. Traill on behalf of the directors of Westland.

In addition to their aircraft having sprung from the American S-58 the squadron will be using two vital items of equipment which are British-built versions of American counterparts. These are dunking sonar and autostabilizing equipment (ASE). The latter fulfils the functions of a conventional autopilot for a helicopter and in addition provides facilities to enable the pilot to enter and maintain the hover without reference to a visual horizon. Value of this capability in making the Wessex an "all-weather" anti-submarine aircraft is self-evident.

Due to the unavoidable—at present at any rate—complexities inherent in the system, two pilots are a normal part of a Wessex crew, the primary responsibility of the second being to monitor the gauges implicit in the ASE. Cabin personnel consist of an observer and an under-water weapons control rating—UC(W) (Aircrew). The former is responsible for navigation and tactical co-ordination whilst the latter operates the sonar equipment. Armament of the Wessex consists of two external stowed anti-submarine torpedoes.

ROC Encampment

OVER 2,600 men and women are attending this year's annual summer camp of the Royal Observer Corps at RAF Binbrook, Lincs, until July 28. During the camp, observers are visiting and working at the nearby ROC group headquarters at Fiskerton, a subterranean unit which in nuclear war would be completely self-contained. Training facilities at Binbrook make it possible for those attending the camp (which is in five phases of a week each) to carry out realistic fallout and other nuclear tasks. The commandant of the ROC, Air Cdre C. M. Wight-Boycott, is visiting the camp tomorrow (July 14).



The new plastic wind tunnel at Hatfield Technical College (see item below)

THE INDUSTRY

Plastic Wind Tunnel

A NEW closed-circuit open-jet wind tunnel recently installed at Hatfield Technical College is thought to be the first fabricated from laminated plastic material. It was made by the Stanboro' Pattern and Model Makers Co Ltd from a combination of Epophen Epoxide resin, glass cloth and resin-impregnated glass mat. The idea of a plastic tunnel stemmed from discussions between the college and the Stanboro' Co, one of the companies invited to submit quotations.

Nearly 80ft long, the tunnel was designed by the aerodynamics staff of Hatfield Technical College in collaboration with the Stanboro' Pattern Co. Diameters range from a minimum of 2ft to a maximum of 4ft. The tunnel was fabricated in sections of various lengths from ½oz glass cloth (Marglass 178/S/36), 2oz glass mat and Epophen Epoxide resin manufactured by Leicester, Lovell and Co Ltd, North Baddesley, Southampton. The grade of Epophen resin selected has a slight natural resilience; a "harder" resin could craze when subjected to the stresses which the wall of a wind tunnel might have to withstand.

Compressed Air Supply

IN the design and installation of compressed-air equipment provided in the main plant room of the BOAC component test house at London Airport, James Howden & Co Ltd, 15 Grosvenor Place, London SW1, have acted as main contractors. This equipment is installed in the three air test cells and control room. Howden have also been responsible for the closed-circuit cooling water system in the building and for the external forced-draught cooling tower, pumping equipment and water-softening plant.

Function of the compressed-air equipment is to supply the air cleaned, dried and heated to three air test cells under any combination of flow, pressure and temperature, within the following ranges: flow, 10-297lb/min; pressure, 45-265lb/sq in; temperature, 35-404°C. The main compressor plant consists of five Howden positive displacement rotary compressors, each driven by a screen-protected squirrel cage induction motor. The compressors are so designed and connected by pipe-work and valves as to allow for single-stage, two-stage and three-stage operation.

Operation of the main compressor plant is carried out from a mimic panel installed in the control room. From this panel the operator can select and start the compressors required for any specific duty, as well as the route by which the air is to pass through the plant and into the test cell where it is needed. The appropriate nozzle can be selected and the appropriate air heater put into or taken out of operation. Final control and measurement of the temperature, pressure and flow in each of the three cells is carried out from the appropriate desk in the control room of the component test house.

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Marconi appointments recently announced are those of Mr F. S. Mockford (left), who relinquishes his post as commercial manager to undertake special duties for the managing director; Mr F. Wheeler (centre), new commercial manager; and Mr H. Baker, deputy commercial manager

IN BRIEF

Air Chief Marshal Sir Francis Fogarty, GBE, KCB, DFC, AFC, has been appointed to the board of Racal Instruments Ltd.

A new maintenance hangar for the RAF is being erected by the Mowlem Construction Co at Embakasi Airport, Kenya. Value of the contract is £27,000.

British Insulated Callender's Cables Ltd announce the appointment of Mr D. I. S. Hinton, BA, as sales manager of BICC-Burndy Ltd, Prescot, Lancs.

Mr Arthur Hughes has been made manager of the aviation division, Goodyear Tyre & Rubber Co (Great Britain) Ltd. He succeeds Mr M. G. Foulger, who is transferred to general sales on special assignment.

Vactric Control Equipment Ltd have changed their address from Vactric House, Sloane Street, London SW1, to 30 Bouverie Street, London EC4 (Ludgate Circus 7061).

Mr Eric Turner, formerly chairman of the Blackburn Group, has been appointed chairman of the Birmingham Small Arms Co Ltd. He joined the company in January last year as deputy chairman and chief executive.

Continental Connectors Ltd are now sole selling agents for products of the components division of Miles Electronics Ltd. Continental Connectors are associated with the Ultra Group; Ultra Electronics Ltd hold a third share in Miles Electronics Ltd.

Dewrance & Co Ltd recently announced the formation of the Dewrance metals division. It consists of the foundry at Hillington and the special alloys division in London. Production executive is Mr J. B. Morton (at Hillington) and the sales and technical executive (in London) is Mr E. Wallace.

Head sales office of Whitehouse Industries Ltd, manufacturers of Philidas self-locking nuts and fixings, has been transferred to new premises at the company's Pontefract works. The new address is Whitehouse Industries Ltd, Monk Hill, Pontefract, Yorks (Pontefract 2011/2/3).

What is described as "the first private heliport in the Midlands" was inaugurated on June 26 when a Westland Whirlwind took Mr D. B. Collett, an executive director of the Dunlop Rubber Co Ltd, from Battersea Heliport to the company's main UK factory at Fort Dunlop, Birmingham, where the new heliport has recently been completed.

Mr J. A. V. Watson, OBE, is to become assistant managing director of Castrol Industrial Ltd upon the retirement of Mr W. F. List on January 1 next year. Mr Watson's appointment as assistant managing director of the parent company Castrol Ltd, to take effect on the same date, had already been announced. He served with the ATA during the war and by 1942 became chief test pilot.

Fifty-eight glass plates 10ft square and ¾in thick have been fitted by Aygee Ltd in the new long-haul passenger-handling building now under construction at London Airport. The total area of glass, glazed to an aluminium frame, is 40,000 sq ft. On the roof of the new building are 260 double-skin Perspex domes, each 9ft by 5ft. The domes are fitted to hardwood curbs under which are Georgian rough-cast laylights made by Aygee Ltd. This is stated to be the largest quantity and area of domes glazed in any building in Gt Britain.

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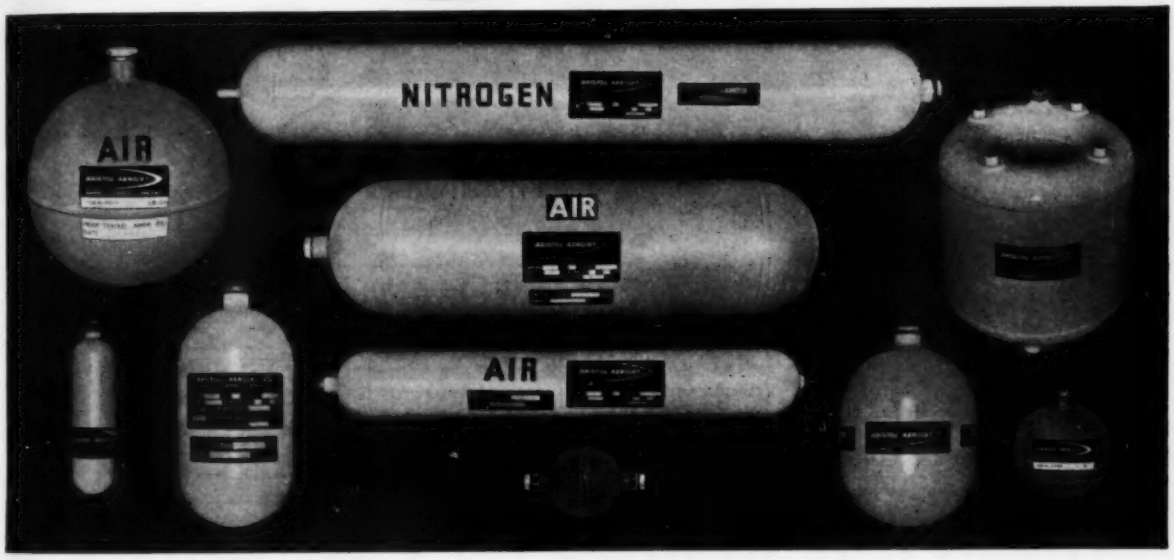

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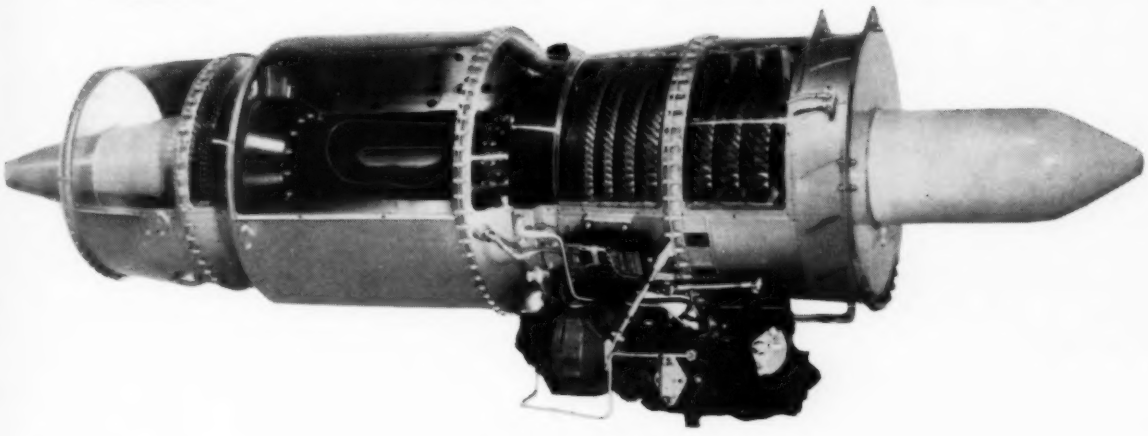

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